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The Morrison Movement.

THE electrical industry is fortunate in having a Minister of Transport whose national and local public service in various capacities, whose relations with electrical development officials, and whose personal experience in an electrified house, have combined to qualify him to talk with authority regarding electricity supply.

In discussing the future of E.D.A. here, recently, we set forth the need for a super-man to tour the country boosting the advantages of electrical service. We felt that a position had been reached where somebody of influence should tour the country stirring up a live and eager interest among the large percentage of the people who so far were ignorant concerning electricity supply and therefore took very little interest in domestic electrical apparatus. Simultaneously such a leader was to make a peremptory call upon hesitant electricity supply concerns and officials to "go forward with a bold and vigorous policy of development on their own responsibility as a duty to the industry itself and to the nation," if we may quote actual words used by MR. HERBERT MORRISON in the electrical constituencies during the last few days.

The Electrical Development Association duly made its appointment, and we believe that excellent results will ensue in due course, but while we are waiting for these Mr. Herbert Morrison, as Minister of Transport, with qualifications already stated, and with the Electricity Commissioners and the Central Electricity Board behind him, is placing the industry under a debt of gratitude.

He has attended a number of conferences of electricity supply undertakers at Glasgow, Manchester, and London, according to the plan summarised in our issue of January 16th (p. 90). Extracts from the statement made by him are quoted on another page to-day, together with notes on the discussions that have followed.

While these conferences may not at once have a direct effect upon the public mind, we hope that they will have a substantial influence upon fearful, faltering, and unenterprising electricity undertakings and their officials who, in their turn, will see that their only proper course is to stir up business amongst the residents in their areas.

We need not reiterate all the means that are available and desirable for securing hosts of new domestic

electricity consumers—they have been driven home at all the conferences and are well known to our readers.

We agree with Mr. Morrison that the electricity supply industry is one of the big self-respecting industries of Great Britain. It is not looking tremulously this way and that in order to find out how to keep alive. On the contrary, it knows well enough that new capital expended in it both affords a desirable investment, highly favoured by the public, and provides work for unemployed men. Possessed by a really progressive spirit, it can so spend on extension work as to make factory and constructional activity for one class of manufacturer, while it can simultaneously promote a big demand from the consuming public for domestic apparatus. At such a time as this it is an unpardonable sin to stay one's hand where legitimate demand for British products awaits satisfaction.

Let every director, committee-man, engineer, manager, and salesman get on with his own job with a new zest, promoting all the electrical trade he can to ensure a record advance in 1931.

The Fair: An Electrical Market Place.

SOME months ago we wrote here urging our readers overseas to make definite arrangements in good time to come Home to the British Industries Fair laden with orders for electrical products. There are no better electrical manufactures than those made in Britain, and brought together as they will be at Birmingham (and to a less extent in London) they will form a fine demonstration at what is, as it ought to be, an increasingly popular Market Place. We read that the Government has received 29 per cent. more acceptances from abroad than had arrived up to the corresponding date a year ago, and we hope that a good proportion of the overseas visitors will be bringing substantial electrical orders. It will not be in the least surprising to us if some exhibitors in 1931 book foreign orders as the result of their 1930 exhibit. A stabilised annual market is the most promising event and encourages the periodical visit, with a continuing interest in our products.

Let us now make a timely reference to the part that should, and doubtless will, be played by the Home trade. Everybody who has taken any part in past Fairs has seen the value of the Castle Bromwich Electrical Market for the placing of orders for Home consumption. The manufacturers once again this year are making a big effort to have their products effectively displayed. It now remains for the buying sections of the electrical industry and trade to make such arrangements as will allow nothing to stand in the way of visits on one or more of the special days included in the programme of the Executive. In a sense every day, with so short a run, is a special day, but naturally we are inclined to place emphasis upon the visits of certain associations and organisations. When the programme of events is issued everybody will be able to make his plans; some may prefer the electrical days, but others favour the visits of non-electrical trading associations, whose members are responsible for substantial electrical purchases What we are anxious to urge at the moment is that everybody will try and go at some time between February 16th and 27th. Let us all once again beat all previous records.

Again this year the ELECTRICAL REVIEW will have a stand in the Electrical Section, where it will be ready to render service to exhibitors or visitors in a variety of ways. We hope to meet many old friends and to make many new ones, both overseas and home.

The Three Strands.

MR. C. C. PATERSON in his presidential tour of the I.E.E. Centres has so far contrived to deliver a different address on each occasion. It is, however, easy to discern a dominant idea and ideal running through them all—the place of science in industry—and his variations on the theme are due only to the diverse angles of approach to the subject that are possible. In choosing the word "ideal," the last impression we wish to create is that associated with its vulgar use as something vague and impracticable, if noble, to which convention has decreed that we shall pay lip service. Mr. Paterson's ideal is essentially related to practice, and has, moreover, taking a not unreasonably broad view, a distinctly commercial value. He has employed various illustrations to emphasise the need for the most intimate relations between science and industry, and, if we refer more particularly to his speech at the dinner of the North-Western Centre, it is because his metaphor on that occasion so tersely sums up what we conceive to be the presidential message. He there likened industry to a rope of three strands (no fewer than three will serve)—commerce, engineering, and science. A traditional habit of thought may tempt the practitioner in any one of the trio to add "and the greatest of these is——," but, in the ultimate event, none can claim to be of pre-eminent practical utility. There must, in fact, be a real working co-operation with science, which must be taken down from its pedestal and put to everyday use. The proper attitude of mind is to regard it as a partner and not as a consultant, and this applies to the supply as well as to the manufacturing section of our industry. How far we are from making adequate use of our scientists is shown by Mr. Paterson's statement that out of 450 Fellows of the Royal Society fewer than 20 are engaged in industry. This is one suggestive pointer for those responsible for the organisation of our national resources.

Colliery Generation.

A PAPER read recently before the Institute of Fuel at Manchester ("Local Generation of Electric Power *versus* the Grid") raised several controversial matters. The paper, which we published in abstract on January 9th, advances what is really the old plea for pit-head generation, but with an essential difference. The author, MR. E. IVOR DAVID, in fact definitely rejects the view that coal mines are the proper places for the erection of large modern stations of the type conveniently (but not altogether happily) called super-stations, but he does suggest that smaller stations equipped for burning cheap fuel can produce and distribute electricity at a lower cost than is possible with large public stations. His view is, therefore, that such of the colliery stations as are able to burn low-grade fuel should be linked together for supplying local needs and export their surplus output to the national grid.

This appears to us, on the face of it, to be a reasonable proposal, and no doubt the Central Electricity Board will be ready enough to purchase cheap power whatever its source may be, if it can be delivered as and when required. There are certain points in the argument, however, which seem to require elaboration and comment. We would first of all like to qualify the author's statement that the place for a generating station is near the centre of the load. The qualification, of course, is that there shall be a copious supply of condensing water available; since between 500 and 600 tons of water are required for every ton of coal burned, this factor must take precedence of proximity to load and of coal resources.

It is shown that some of the best-known super-stations were constructed at a higher capital cost than several smaller industrial stations. The value of the comparison seems to us to depend upon some factor, not sufficiently accounted for by greater elaboration of the super-station, that inherently favours lower costs for an industrial station; otherwise it merely proves that some large stations have cost more to equip than some small ones. We mention this because it is claimed that the difference in capital expenditure would compensate for the lower cost of money to the Board.

Fuel consumption for the super-station is taken at 1.38 lb. per kWh, but we believe that the figure for Kearsley of 1.18 lb. per kWh (see our issue of October 31st last), with adjustments for the higher load factor of the base-load station, more nearly represents future probability.

On the question of load factor generally some remarks are called for. Mr. David points out that a group of collieries might have a load factor as high as 70 per cent., while the grid load factor would be only about 40 per cent., from which he deduces that capital charges and wages cost per kWh would be approximately the same for the industrial station as for the super-station. The load factor of a super-station may also be expected to be about 70 per cent., but that is not really material to the argument. The costs incurred in giving a supply should have regard to the load factor of utilisation rather than of generation, and in that case capital charges, wages, and coal (an appreciable proportion of which should be regarded as a standing charge) would be scaled to meet the conditions of utilisation.

There are other points that we should like to take up, *e.g.*, the economics of giving stand-by and meeting peaks from a transmission system (the charges on which are almost entirely standing), but these must wait for some future occasion.

Honorary Officials.

THERE can, we think, be no doubt that the present strength of the Institution of Electrical Engineers is due to its wise policy of fostering and encouraging the development of local Centres and Sub-centres. The vigour of the Institution is in its limbs as well as in its head. The vitality of local bodies in their turn depends very much on the services of their committees and officers, whose voluntary work makes a large call upon their time and thought. Those who undertake such labours have their reward in the esteem and gratitude of their fellow engineers, and also in the consciousness that they have done what in them lies to raise the standard of their profession to the point of fitting it to become a dominating influence in the foremost industry of the age.

At the dinner of the Western Centre MR. E. G. OKELL referred to the long period of service to his profession, apart from his regular duties, given by MR. C. T. ALLAN, who recently retired from the position of honorary secretary to the Committee. Mr. Allan had held the position for 16 years. We should be glad to know whether there are any other electrical engineers with longer periods of service as honorary secretaries to their credit.

An Act of Recognition.

THE large number of ladies present at the annual dinner of the I.E.E. Western Centre last week enabled Mr. S. B. HASLAM to say that the Electrical Association for Women was the most fully represented of the kindred societies at the function. Mr. Haslam then made a graceful reference to the honour recently bestowed upon the Director of the Association, MISS CAROLINE HASLETT, C.B.E.

The wider and more practical significance of this honour was implicit in Miss Haslett's reply. It forms, apart from its personal aspect, an official act of recognition of the fact that within a few years of its formation the E.A.W. has won its right to be regarded as an indispensable unit in the electrical industry.

Insulation Engineering.

THE abstracts of the two papers read before the I.E.E. last week and reported in this issue did not, and indeed could not in the time available, deal adequately with the wealth of their subject matter; both papers should be re-read at leisure. The authors of "Dielectric Phenomena at High Voltages" (MESSRS. B. L. GOODLET, F. S. EDWARDS, and F. R. PERRY) point out that to proceed on existing experience alone is a very costly way. They also note the considerable difficulty in correlating the results obtained by other investigators, and in presenting a record of original work (covering all voltages up to one million) they have had regard to the unity of outlook underlying researches into the breakdown of air, oil, and solid dielectrics by normal-frequency, impulsive, and high-frequency voltages. The references to the earlier researches of others and the examination of the reasons why some of them have failed to provide adequate explanations of phenomena (as in the case of the thermal theory of breakdown) are also of great interest, though we wish, with one speaker in the discussion, that space had permitted the incorporation of a few generalisations.

Many engineers find a mechanical analogy useful in the comprehension of electrical theory, and the authors have made their investigations easier to follow by drawing attention to the similarity in the problems of insulation design and those relating to the strength of materials.

Emphasis is rightly laid on the fact that, while power-factor measurements are becoming increasingly important, they can be interpreted adequately only from a large amount of data. We imagine that the observations on the breakdown of oil of commercial quality will arouse interest. The cathode-ray oscillograms shown on the screen of periods of one half-millionth of a second provided scope for admiring comment.

The paper on "High-Voltage Testing Equipments" (by MESSRS. E. T. NORRIS and F. W. TAYLOR) provides a good example of the presentation of research experience for the benefit of the engineer called upon to install or use such plant in buildings not always designed for the purpose, and proves the authors' claim that British work and thought take a prominent place in high-voltage engineering. As "testing" is here understood to include all purposes except the commercial supply of electricity, it will be seen that the scope of the paper is ambitious. The maximum (peak) voltage of the apparatus described is 1,800,000, but all conditions likely to be required (including sustained low frequency) are catered for.

The discussion on the papers was of a high order and would have no doubt been prolonged to an unreasonably late hour had the rules permitted. Mr. P. DUNSHEATH was responsible for a very suggestive idea embodied in the view that the minimum voltage at which any deviation from excellence was noted should be measured, instead of determining dielectric breakdown voltage.

A Ferranti Memorial.

IN arranging a memorial address on the life and work of Ferranti on the first anniversary of his death, the E.P.E.A. (technical group) in Manchester did a good thing.

MR. FRANK BAILEY, in summarising the career of the great pioneer, which began several years before the passing of the first Electric Lighting Act, enabled one to realise how very intimately that career was bound up in the development of electricity supply as we know it to-day, so that, like Æneas, Ferranti could have said, "A great part of it, I was."

Ferranti's work is now part of the common inheritance of the electrical engineer, but, as was pointed out by us a year ago, he also left as a heritage something which was not transmutable into matter, but which, we believe, will prove as potent a factor in electrical progress as his inventions. We refer to the quality of spirit that has been termed "the Ferranti faith." We feel sure that we only give expression to the views of many engineers, whatever the part of the country they regard as their own, when we suggest that the example of Manchester may be followed in future years.

It would be a noble gesture on the part of any person, or group of persons, who believe that eagerness of spirit—that eagerness which alone makes it possible for the practical work-a-day mind to draw fully upon its dormant faculties—is too valuable an inspiration to be forgotten, to endow an annual Ferranti lecture. Such a lecture should, in our view, have as its object the preservation of the spirit of Ferranti in the mind of the young engineer. It should seek to foster in him faith in the potentialities and the social value of electricity, faith in the ideals of his profession, and faith in his own ability to use the opportunities provided by electricity for the exercise of his talents.

Developments in Japan.

Some details of the water-power plant at Kanose and Toyomi, the former being one of the largest and best examples of its kind in that country.

By CHAS. J. WEBB, A.I.A.E.

DURING the past ten years the development of the water-power resources of Japan has been proceeding actively and several large hydro-electric power stations have been completed or are in course of construction. As an example of low-head power development we are able, by the kindness of Mr. Kumao Mino, chief engineer of the Toshin Electric Co., Ltd., of Tokio, to publish particulars and illustrations of the Kanose hydro-electric station constructed by that company in the Province of Niigata, about 36 miles from the city of that name. It utilises the water power of the Aganogawa (Agano River), which begins at the confluence of two rivers, Tadami and Nippachi, the former being fed by the perpetual snow of the high mountain ranges extending over the Iwashiro and Echigo provinces, while the latter is the only outlet of the famous Lake Iwashiro. The fact that the Aganogawa flows for its greater part through mountain regions bordered on either side by ranges of steeply rising hills offered sites most suitable for dam construction.

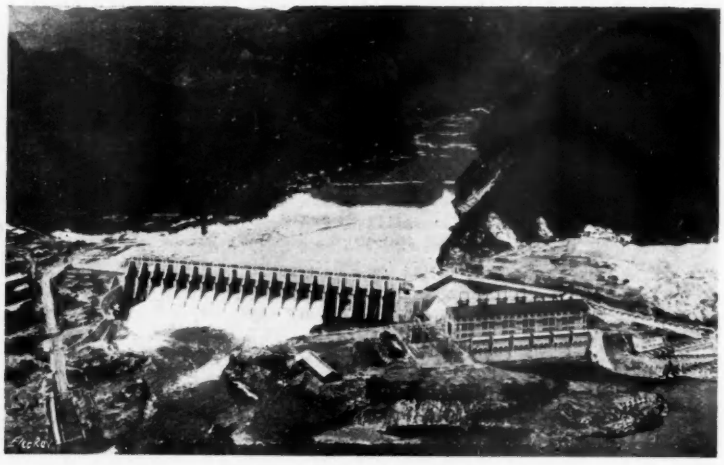

Fig. 1.—Kanose Power Station and Dam.

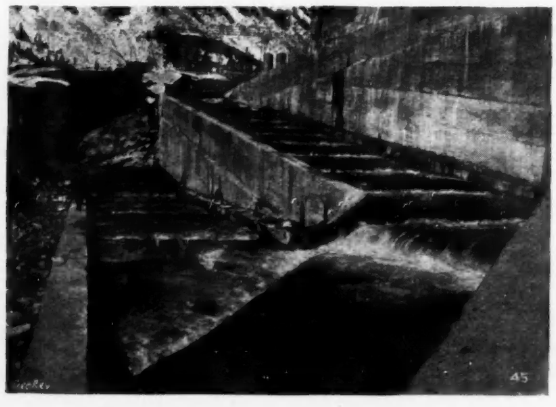

Fig. 2.—Part View of Fish Ladder.

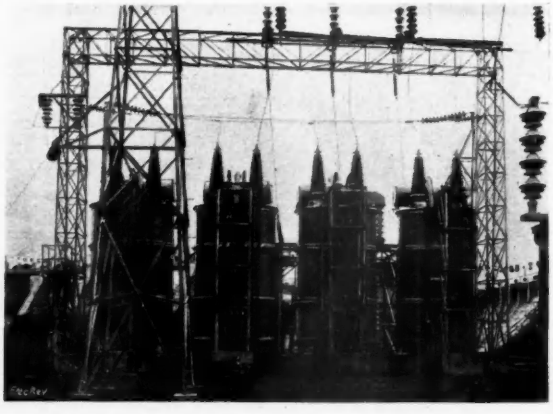

Fig. 3.—Out-door 11/154-kV Transformers.

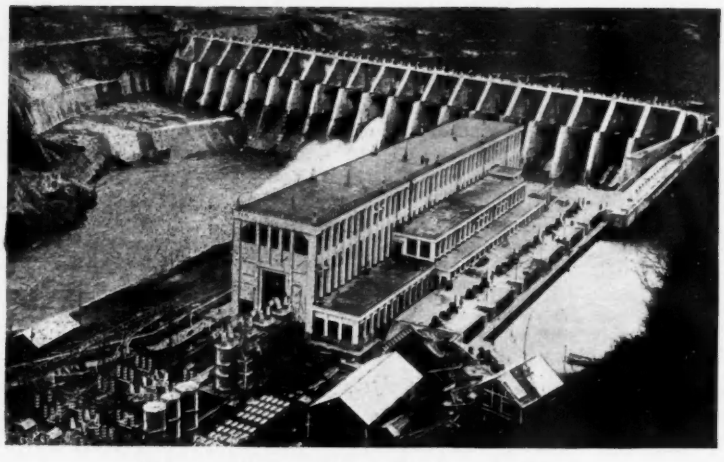

Fig. 4.—Toyomi Power Station and Dam.

The dam is of solid concrete masonry (fig. 1) designed as a gravity section. Its total length of 998 ft. consists of 714 ft. of gate-controlled spillway section and 284 ft. of bulkhead section. The storage capacity formed by the dam totals 120 million cu. ft.; the available water supply is, however, 60 million cu. ft. Taintor movable crest gates, measuring 30 ft. by 32 ft. in dimensions, claimed to be among the largest of their kind in the world, are installed, three of the 20 being equipped with automatic operating mechanism. The gate piers, 6 ft. thick by 60 ft. high, are built of rein-

forced concrete and support a 20-ft. wide ferro-concrete bridge upon which the operating mechanism for the gates is mounted; also in the piers are imbedded the shafts for the gates. The operating mechanism consists of long chain links, geared mechanism (either hand or electrically operated) and 50-h.p. electric motors controlled from the switchboard. When all the 20 gates are fully opened 320,000 cu. ft. per sec. of water can be discharged. The intake is located on the left side of the dam and is built of reinforced concrete, there being nine sluice gates each with a span of 15 ft.

The power station (fig. 1) together with a forebay of an area of 52,800 sq. ft. and a capacity of 1,426,000 cu. ft., is located on the left of the dam and consists of a three-storey building of steel girder and concrete construction, its dimensions being: length 308 ft., width 77 ft., and height from the generator floor 51 ft. Owing to the possibility of flooding it was necessary to allow a height of about 50 ft. between the generator floor and the turbines' centre line (fig. 6) and also to build a strong wall to withstand the lateral water pressure on the tail-race side. A lift operates between different floors.

The tail race is an open canal with concrete sides, its dimensions being: max. width 256 ft., min. width 100 ft., and height 16 ft. An elaborate fish ladder (fig. 2) meets the strict requirements of the Fishery Department of the Japanese Government. Its total length is 1,320 ft., width 18 ft., and it has a gradient of 1 : 15; it starts on the left side of the intake, skirting round the forebay, power house and tail race, and ends a few feet downstream where the tail race meets the main stream.

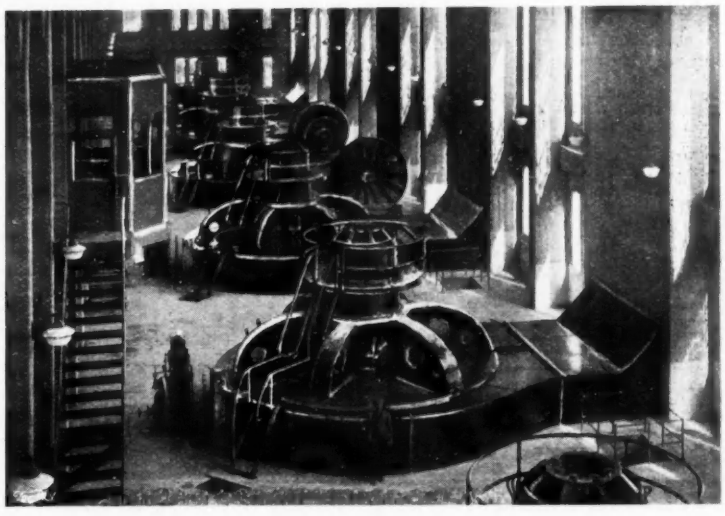

Fig. 5.—Generator Room at Kanose.

The initial plant at Kanose comprises six 12,500-h.p. turbo-generators, one set being kept as a spare (fig. 5). The turbines are of the single Francis pattern, of Escher Wyss construction, and run at 150 r.p.m. under a net head of 74 ft. The main alternators are of the American General Electric Co.'s construction, generate at 11,000 V, and are designed to develop 9,400 kVA at a power factor of 85 per cent.; they are each provided above the thrust bearing with a 90-kW, 250-volt, compound-wound exciter. The main generators are approximately 22 ft. in diameter, 14 ft. in height, weigh about 140 tons, and have their neutrals brought out and earthed. Three of them are connected together to the bus-bars, the two sets of bars being connected together by oil switches without reactor.

The station auxiliary system is divided: (i) for supplying the essential auxiliaries of each of the main sets, for the two motor-generators for battery charging, and station lighting, three 100-kVA, single-phase, 11,000/105-210-V transformers (fig. 7) have been installed; (ii) for operating the outdoor gates, motors, and the exterior lighting there are three 100-kVA, 11,000/3,300-V, single-phase transformers, the voltage being further stepped down to either 200 or 400 V.

The whole work was completed in two years and three months, a record for Japan. The following quantities were involved in the construction of the dam and power house: rock excavation, including tail race, 550,000 cu. yards; concrete 275,000 cu. yards; structural steel 1,600 tons; reinforcing steel 1,200 tons; hydraulic and electrical machinery 5,700 tons.

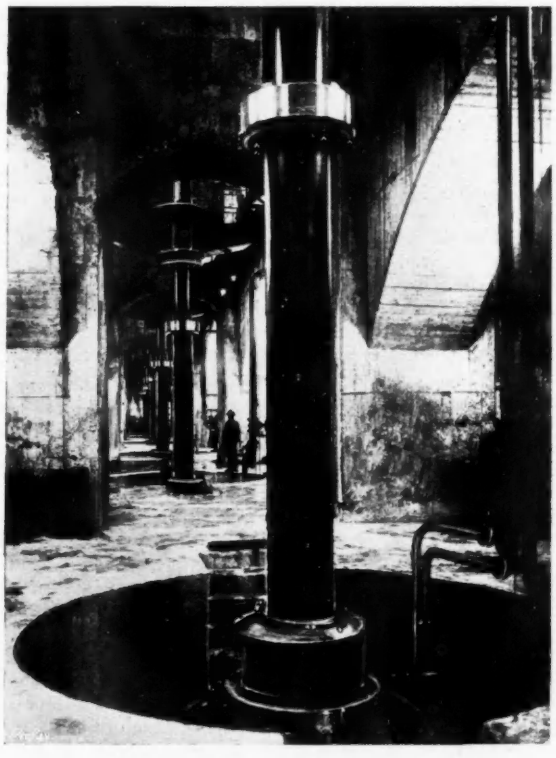

Fig. 6.—Intermediate Turbo-alternator Shafts.

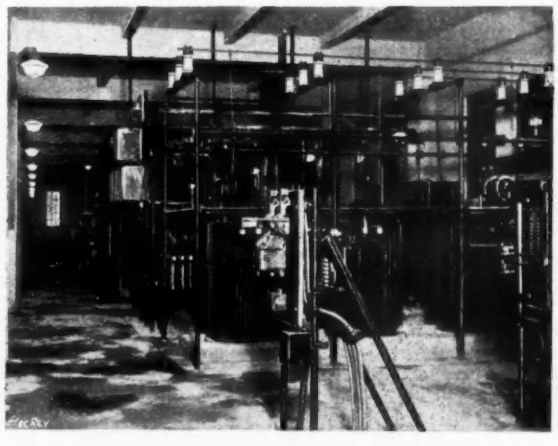

Fig. 7.—Indoor Transformers, Kanose.

The Toshin Co. has also lately completed a second hydro-electric station at Toyomi, on the same river

several miles below the Kanose plant. The work there included the construction of a gravity-section dam 678 ft. in length to provide a storage reservoir of 120 million cu. ft., although, as at Kanose, only 60 million cu. ft. of water is available. The effective discharge of water is estimated to vary between 3,200 cu. ft. per second in the dry season and a maximum of 8,000 cu. ft. per second. The construction of the dam and tail race involved the excavation of 797,200 cu. yards of rock; 19 Taintor gates measuring 30 ft. by 32 ft. are installed, while the intake is fitted with six sluice-gates, each having a span of 15 ft. The forebay has an area of 53,317 sq. ft. and a capacity of 1,599,000 cu. ft. The head gate is of the sector type and is 24 ft. in width by 22 ft. in height.

The power house (fig. 4) which is located on the left side of the dam, is a two-storey building of steel girder and concrete construction, 307 ft. in length, 77 ft. in width, and 58 ft. in height. The plant comprises six Francis 14,000-h.p. vertical, single-spiral, single-discharge turbines coupled to 11,000-kVA alternators generating a total of 45,000 kW at 11,000 V at 150 r.p.m., the effective head for the turbines being 82 ft. The turbines, generators, and switchboard are all of Japanese construction, having been built by the Hitachi Engineering Works, Ltd., of Tokio.

The installation includes what is described as the most elaborate fish ladder in Japan, it being 1,800 ft. in length and 18 ft. in width. There is also a log incline on the left side of the forebay with an electrically-operated cable truck, 57 ft. long by 16 ft. in width, working on a 9 ft. 3 in. track. The whole plant was completed in two years and five months.

The power of both the Kanose and Toyomi stations is transmitted at a pressure of 154,000 V to Tokio, a distance of about 170 miles; there are two outdoor 11,000/154,000-V step-up sub-stations (fig. 3) located near the respective power stations, the first plant having a normal capacity of 40,000 kW and the second 45,000 kW. The main transformers at the former sub-station, which were constructed in Japan by the Shibaura Engineering Works, comprise four 15,000-kVA units, one being in reserve. They are Y-connected on the 154-kV side with an earthed neutral, the 11-kV side being delta connected. The oil circuit breakers, also of Shibaura construction, are rated at 154 kV and 800 amperes, the rupturing capacity being 5,500 amperes.

Transformer Design—II.

The protection of the windings against surges by means of external apparatus which reduces the steepness of the travelling waves.

By E. T. NORRIS, M.I.E.E., Fellow A.I.E.E.*

THE stresses in a transformer resulting from surges have been studied intensively in recent years. The results of some of the tests carried out on actual transformer windings at Hollinwood are shown in figs. 6, 7, and 8. In fig. 6 a transformer with ordinary insulation and winding arrangement, that is, an arrangement designed without special regard to surge stresses, was subjected to surges and the distribution throughout the winding measured. It will be seen that this curve A is of the same general shape as curve A in fig. 5 in Part I†, which is of independent origin. Neither curve gives stresses appreciably worse than uniform distribution in the body of the winding. Comparison of these curves with the imaginary curve C of fig. 4 shows that under practical conditions there is no danger from oscillations.

It should be noted, of course, that curve C of fig. 4 can easily be reproduced by sending surges of infinite wavelength into a transformer. As, however, such surges are of no practical importance, curve C is of purely academic interest.

Even if surges of sufficient length to cause stresses of the magnitude shown by curve C were practically possible, a certain amount of automatic protection would be obtained through the impulse ratio of the transmission line insulators. For example, a transmission line insulation which will pass a 5 micro-second surge of 1,000 kV maximum amplitude, without flashing over, will pass only a 60 micro-second surge of 660 kV amplitude. For longer surges the amplitude would be even further reduced. The actual stresses between different parts of the windings and ground will be diminished in proportion to this amplitude reduction through the action of the line-insulator impulse ratio alone.

Effect of Specially Designed Windings.

If, now, the insulation of the transformer windings is designed with regard to stresses set up by surges, the voltage distribution can be improved considerably even over the values given in fig. 6. The special features in the design are those previously referred to, such as electro-static end rings, the correct proportioning of the windings, and appropriate insulation between turns and coils. The results of tests on such a transformer are shown in fig. 7. A comparison with fig. 6 shows that the distribution is greatly improved, and in particular the stress on the end turns is very much less.

The stress between turns and coils, which experience has proved to be by far the most common cause of transformer breakdown, is shown more clearly in fig. 8. In order to confirm experimentally the calculated effect of winding-insulation design upon surge stresses, a three-phase core-type transformer was built having windings on each leg exactly similar except for differences in the insulation between turns and between coils. In winding A this insulation was exactly in accordance with standard transformer practice. In winding B the insulation was unchanged, but electro-static end rings were fitted at each end of the winding. The insulation in winding C, however, was especially designed with regard to surge stresses and potential distribution. Electro-static end rings were fitted at each end of the winding, and the insulation between turns and between coils was so proportioned as both to control the surge potential distribution and to give greater security against the resulting stresses. It will be observed that with this winding the stress on the end turns was only 27 per cent. of the corresponding stress in winding A, whilst the potential gradient in the conductor insulation was correspondingly less. The special features of winding C did not involve any additional expense; in fact, the cost of all three windings was practically the same.

Principle of Graded Insulation.

It is reasonable to suppose that in most cases the adoption of elaborate and costly expedients for reducing internal stresses has been the result of abnormally serious failures in the ordinary type of transformer,

* Chief Designer, Ferranti, Ltd.

† Part I was published in the ELECTRICAL REVIEW of January 23rd, 1931.

due to lightning disturbances. In most cases, such troubles have occurred principally in transformers having graded insulation where the neutral point is in service, solidly grounded. Both British and American National Standard Specifications have legislated for this type of insulation by calling for an induced-voltage test of 2.73 times normal. With such a test the line end of each phase winding receives a test potential of 2.73

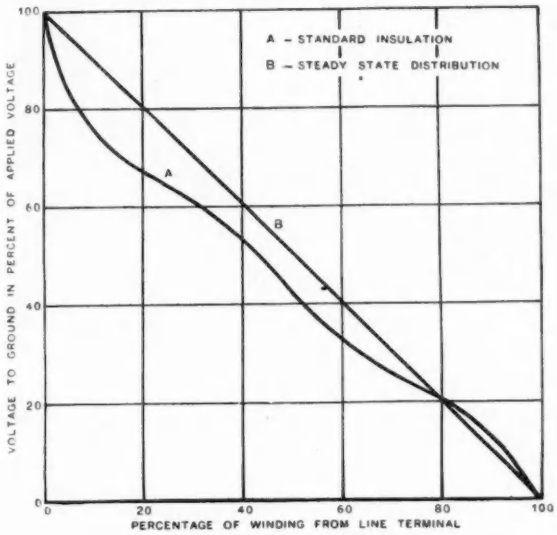

Fig. 6.—Oscillation Voltage with Standard Construction.

times the normal voltage between line and neutral. In a standard fully insulated transformer the test pressure called for in all standard specifications is twice the line voltage; that is, the line end of each phase winding receives a test potential of twice the line voltage, or 3.46 times the normal working voltage between line and neutral.

The essential principle of graded-insulation transformers is that advantage should be taken of the fact that the neutral point is solidly and permanently grounded to reduce the insulation to earth at the neutral end of the winding. It is no part at all of this essential principle that the line end of the winding should be any less well insulated than in ordinary transformers. It is unfortunate that, in order to balance corresponding power frequency stresses, the standard specification called for a test pressure at the line end of the winding of only 2.73 times normal for the graded insulation transformer, instead of 3.46 times normal.

Nature of Stresses.

The complete and comprehensive design of a transformer insulation must take into account all of the stresses the insulation will be subjected to in its subsequent life. The stresses include:—

(*a*) The standard pressure and over-potential tests.

(*b*) The normal working-voltage stress applied continuously for the whole life of the transformer.

(*c*) Surges and other transient-voltage stresses which the transformer may have to experience in the course of its normal life.

For some parts of a transformer insulation item (*c*) will be the most severe stress; for other parts, items (*b*) or (*a*). Each part must be designed to meet the conditions set up by whichever of these items causes the most severe stress.

Referring now to the graded-insulation transformer, so far as pressure tests are concerned, the insulation at the line end of the winding could be reduced in the ratio 3.46 to 2.73, but surges and travelling waves entering the transformer from the line impose just as severe a stress on the line end of the winding, whether the insulation is graded or no. Therefore, it is essential that the insulation at the line end of the winding should not be reduced for graded-insulation transformers; that is, no advantage can safely be taken of the fact that the test pressure stresses are reduced in the ratio 3.46 to 2.73. Many graded-insulation transformers for line voltages up to 132 kV have been built in this way since 1921. In all of them the insulation at the line end of the winding is exactly the same as if the transformer were fully insulated. The proportion of failures of these transformers has been even less than in fully insulated transformers.

Coming now to item (*b*) of the problem, as set out in Part I of this article, the stresses within the windings resulting from a surge can be controlled in the same way as the stresses between windings and ground, which have already been considered. Fig. 8 shows how the distribution of stress can be improved by suitable design of the windings and insulation. If, in addition, electrostatic shields are fitted, then, in the ideal case with uniform distribution, the stresses between turns and coils will be the same throughout the windings. If, for example, winding c were fitted with additional electrostatic shields, the dotted line c_1, as shown in fig. 8, could be obtained. The stresses between turns and coils at the line end of the winding have been reduced, whilst in the body of the winding the stresses have been increased.

Methods of Reducing Stresses.

Since the main effect of improving the distribution of a surge throughout the winding is to reduce the stress between turns and coils at the line end, comparison of the various methods may be obtained by considering these stresses only. If the voltage between turns at the line end of winding A resulting from the surge is 100, then from fig. 8 the voltages for the other alternatives, with the same surge, would be as set out in the following table:—

(1) Standard insulation with electro-static end rings	66
(2) Specially designed insulation with electro-static end rings	27
(3) Winding with shields giving uniform distribution	10

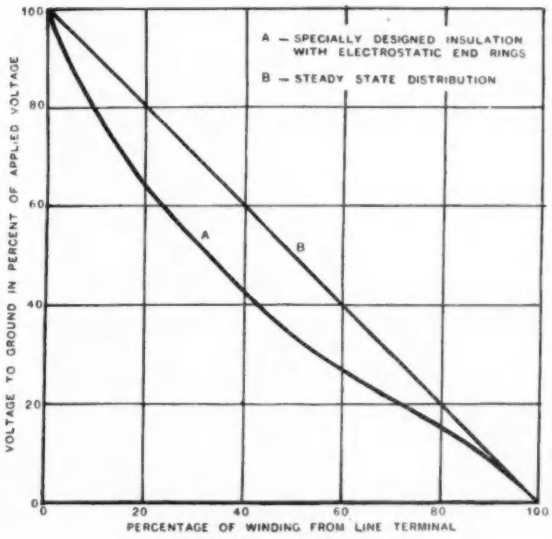

Fig. 7.—Effect of Special Design.

(4) Practical design of winding with shields ...	15
(5) As item (2) but with Ferranti surge absorber connected between the surge generator and the transformer	4

A uniform distribution of the stress would require a theoretically perfect and complete shielding arrangement. Item (4) in the table gives an average value for a practical design of transformer with shields.

It appears, therefore, that the addition of shields at line potential will reduce the stress at the line end of the winding in the ratio 27 to 15. It is apparent that

the extra cost and complication of shields are not justified by this reduction. Moreover, the figures just considered refer to voltages between turns. In an actual design, of course, the insulation between turns at the line end of the winding would be increased to allow for the additional stresses. It is only if no advantage is taken of the addition of shields to reduce the insulation between turns at the line end of the winding that the stresses will actually be reduced in the ratio 27 to 15.

The foregoing technical exposition of the problem has been given in order to show that, if suitable precautions are taken in the design of transformers, stresses due to surges may be reduced so far as is practicable and economically possible. More elaborate arrangements, including shields at high potentials, are not only not worth while, but also a very real source of danger and operating risk.

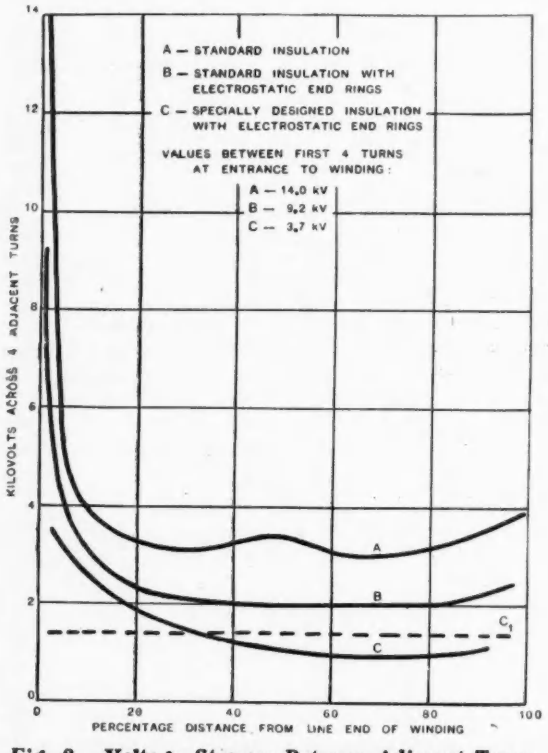

Fig. 8.—Voltage Stresses Between Adjacent Turns.

The ideal design of transformer, from the lightning point of view, would, of course, be one which would safely withstand an infinite number of the most severe surges permitted by the impulse flashover voltage of the line insulators. This is not at present either a desirable or practicable proposition. So far as is known, no transformer manufacturer is able to guarantee unconditionally that his transformer, even if fitted with electro-static shields, will withstand any number of the worst surges possible without some external protective device or means of limiting the stresses otherwise possible. Realisation of this position has resulted in the use of lightning arrestors, weak links in the line insulation, protective spark gaps, &c.

Cumulative Effect of Surges.

There is an essential and important difference in the reactions of a transformer winding and a bushing or line insulator to a surge. A bushing or line insulator flashes over when the surge exceeds a certain value, but will withstand any number of surges below that value without harm. A transformer winding, on the other hand, consists largely of solid insulation. It is an important characteristic of such insulation that the damage done by surges is cumulative and progressive. Whilst, therefore, a single surge of sufficient magnitude will break down a given insulation, a number of surges of much smaller magnitude will also break it down. The damage done to a transformer by surges is so cumulative that its life is definitely limited, and will depend entirely upon the number and severity of surges inflicted upon it.

A transformer of modern design may withstand easily one surge of the maximum value permitted by the line insulations. It would not, however, be practicable to construct a transformer which would withstand a large number of such surges. For this reason, no manufacturer is able to guarantee that a transformer will withstand an infinite number of surges without some external protection.

The life of a transformer, so far as surge strength is concerned, is, therefore, entirely a matter of the frequency and severity of the surges it receives. Owing to the erratic distribution of thunder storms and lightning strokes, this life is governed largely by chance and coincidence.

External Protection.

Since a self-contained lightning-proof transformer is not practicable, reliable operation can be obtained only by providing additional and external protection of the transformer. Experience has shown abundantly that all failures of transformers due to surges are caused by the stresses between turns and coils, and not between high-voltage and low-voltage windings or between coils and earth. The actual breakdown need not necessarily occur between the turns. It may be a failure of the major insulation of the transformer caused by concentration of stress on the end turns, and not by the amplitude of the voltage to ground.

The ordinary discharge-type of lightning arrestor which attempts to give protection by grounding the line and, thereby discharging the surge to earth, operates essentially on the amplitude of the wave, and is, therefore, in principle, the wrong kind of device to protect a transformer winding.

The action of the Ferranti surge absorber is dependent upon the transient nature of a surge which is the inherent cause of abnormal stresses within a transformer. It reduces the steepness of a wave by abstracting its energy and by flattening it. Tests have shown, and operating experience confirms, that the absorber reduces the stress within the windings by approximately 85 per cent. Referring to the table above, the result of installing a surge absorber in conjunction with the transformer item (2), is to reduce the stress from 27 to a comparative value of 4, as shown in the last item of the table. This stress is approximately one-quarter of the stress that would be obtained with a transformer provided with a complete arrangement of electro-static shields. It appears, therefore, that the combination of a skilfully designed transformer and a surge absorber not only ensures much greater security against transformer failure than any other method, but also gives considerable promise that it will provide a complete solution to the problem, in that the life of the combination under operating conditions will not be determined by the number or severity of the surges it receives.

Testing Welds Magnetically.

An advance in methods of testing welds in production without destroying them was explained by Mr. T. P. Watts, of the research laboratories of the Westinghouse Electric and Manufacturing Co., in a paper he presented before the American Welding Society. For butt welds, in which the edges of steel bars or plates are welded together without lapping, he has developed magnetic methods of testing which can be successfully applied with simple easily portable apparatus, which require very little skill and training on the part of the tester. The tests are made by " bridging " the welded seam with a large horseshoe electro-magnet and " exploring " the magnetic field in the vicinity of the weld with a meter. The meter pointer indicates the " reluctance " of the weld by " reading " the magnetising forces across the weld, as compared with the magnetising forces of the steel plate. The method is practically indifferent to the depth of the fault below the surface, and is only slightly affected by rough and uneven surface.

Superannuation for Electricity Supply Men.

By J. W. THOMAS, LL.B., B.Sc., A.M.I.E.E. (Barrister-at-Law).

THE recent rejection of the offer of the post of Town Clerk of Douglas by the selected candidate because its acceptance would involve the sacrifice of his expectations under a superannuation scheme, serves as a basis on which to make some observations upon a matter which is becoming of great importance to engineers engaged in electricity supply. The official concerned was in the service of a local authority which had a scheme of superannuation in force and, as the Douglas Corporation had none, the severance from his present position would have meant his losing the advantages of a scheme to which he had contributed for many years and would have prevented him from enjoying a pension at the expiry of the allotted time.

The difficulty with which this official was confronted presents itself sometimes to engineers in the supply industry when contemplating a change of position from one electrical undertaker to another. They hesitate to relinquish their connection with an undertaking which has a superannuation scheme for one which has not, even though the prospective post may offer other advantages in the way of status and salary. Engineers, like other professional men, desire to have some provision for old age. They cannot look forward without a certain amount of anxiety to a time when their services will no longer be required and they will be thrown for an existence upon their own resources, which, in many cases, will be only a small sum which they have managed to save for themselves. They naturally therefore prefer to be employed by an undertaking which offers some provision for old age rather than by one which does not, other things of course being approximately equal. This applies more to-day than it did twenty or thirty years ago. In the early days of the supply industry the question of superannuation was not thought of very much. Most engineers were young with many years of life before them and old age seemed so remote that it did not enter seriously into their calculations. To-day a large percentage of supply engineers are in their middle years and some are bordering on old age. The need for some form of superannuation has thus become more insistent, and it is not to be wondered at that when considering a change of appointment they should take into consideration the question as to whether the prospective position is covered by a superannuation scheme. If they are already covered by such a scheme they hesitate to accept a position with an undertaking that is not, or alternatively, if they are not covered they prefer to take up a post with one which offers them the advantage of a scheme. One has in fact heard of more than one case in which engineers have been prompted to leave one undertaking for another solely because they desired to become participators in some form of superannuation benefits.

Why Municipal Employment is Preferred.

This is one of the reasons why many supply engineers prefer service with a local authority to that with a company. Whilst opinions may be divided as to the superiority of one as compared with the other in regard to general conditions of employment, there is one advantage which municipal employment usually possesses over employment with a company, *viz.*, that the former as a general rule makes some provision for superannuation, whereas the latter does not. It will probably be true to say that most municipal undertakers of any size have superannuation schemes in operation, whereas the same cannot be said of company undertakers. A table was recently published in the *Journal* of the National Association of Local Government Officers which showed that the major portion of the large local authorities had adopted some scheme of superannuation.

In the annual report of the Minister of Health, recently published, particulars are given as to the number of authorities which have adopted the 1922 Act since it was passed. Approval has been given to its adoption by 220 local authorities, *viz.*, 42 county councils, 51 county borough councils, 4 metropolitan borough councils, 56 borough councils, 49 urban district councils, 11 rural district councils and 7 miscellaneous authorities. The Minister has also approved 19 combination schemes and agreements by which authorities which have adopted the Act admit to its benefits officers and servants of other authorities or statutory undertakers. Ten local authorities have substituted the Act of 1922 for superannuation schemes previously in operation. Approximately 152,000 officers and servants have been brought within the Act.

Company undertakers during the last few years have awakened to the fact that they were labouring under a handicap as compared with municipal undertakers, and some of them as a result have taken steps to institute some form of superannuation or pension scheme. They have probably recognised that they have not the same sphere of choice when selecting men as they would have if they could offer some provision for old age similar to that which is offered by the municipal authorities.

How Employés and Employers Benefit.

The advantages of superannuation are well known and need only be touched upon briefly. From the point of view of the employé the necessity of having to contribute weekly or monthly to a superannuation scheme is a form of compulsory saving and is a great boon to those who have not acquired the habit of saving for themselves. Everyone knows how easily money slips through one's fingers, and how difficult it is to set apart a regular sum for future use. When a deduction is made from one's salary it is not felt so much as when it is made voluntarily after the salary is received. Moreover, in the case of a superannuation scheme the amount contributed is augmented by contributions from the employer. The money put aside under a superannuation scheme is safely invested and is not subject to the vicissitudes to which investments in the ordinary stock market are subject. The funds also are not exposed to calls from which an ordinary banking account would not be immune. The longing to possess a motor car may result in savings being used which ought to be kept to provide for old age. Finally, the money which is invested comes back to the individual in the form of an annual income and not as a lump sum and thus his future is assured.

From the point of view of the employer a scheme of superannuation is a means of encouraging continuity of service. It enables the employer to feel that there is a definite provision for his staff which is independent of the prosperity of his business. The enlightened employer knows that it is not fair to cast off his old servants without some provision. At the same time he knows that a non-contributory pension scheme is costly and may be subject to the fluctuations of his business.

Other advantages to be derived from a superannuation

scheme for employés were cogently set out in the report, issued in 1928, of the Departmental Committee on the Superannuation of Local Government Employés. The Committee pointed out that authorities which have no superannuation scheme in operation usually retain in their service persons who are no longer capable of performing efficient work. This is done on humanitarian grounds, but it has the unfortunate effect that it tends to jeopardise the efficiency of the public service by the retention of men no longer fitted to perform their duties adequately. If they could be superannuated, say, at 65, and their places taken by younger and more efficient persons, it would be to the general good of the service. The retention of these old employés has a depressing effect on the young ones as they block promotion and are often a hindrance to mobility in the department.

The absence of a scheme prevents freedom of movement between one local authority and another and restricts the choice of suitable candidates when a vacancy occurs. A local authority cannot draw candi dates from the staff of other authorities if it has no scheme of its own. Restriction of movement of this kind is unfavourable to efficiency. The Committee was emphatically of the opinion that as a matter of principle and general policy it was in the interests of the service that comprehensive systems of superannuation for all local Government employés should be instituted. It further pointed out in the report that with few exceptions public officers are already pensionable. Thus established civil servants, teachers, poor law officers, police and prison officers, asylums officers and fire brigade officers, are subject to the provisions of public general superannuation Acts. Electricity supply is usually regarded as a public service, at least it is generally spoken of as being such at public functions, and it should therefore enjoy the privileges which attach to other forms of public service.

The Superannuation Act of 1922.

During the last few years the Electrical Power Engineers' Association has been giving the matter careful consideration and has used its best endeavours to induce undertakings, both municipal and company, wherever possible, to institute schemes of superannuation. In regard to municipalities the problem was simplified by reason of the Local Government and Other Officers' Superannuation Act, 1922. This is a general Act which can be adopted by local authorities and other public bodies and put into operation at an appointed date on the local authority passing a resolution by a majority consisting of not less than two-thirds of the members of such local authority present and voting at a meeting called for the purpose, providing such resolution is subsequently confirmed by the Minister of Health. The Act enables a local authority to establish separate funds for officers and servants, respectively. Subject to the provisions of the Act, every officer and servant who shall have completed 10 years' service and shall have become incapable of discharging the duties of his office by reason of ill-health or infirmity, or who shall have attained the age of 60 and have completed 40 years' service, or who shall have attained the age of 65 years shall be entitled, on ceasing to hold his office, to a superannuation allowance according to the scale provided by the Act. The allowance payable amounts to one-sixtieth of the average salary or wage during the previous five years for every year's service during which contributions were paid, and one hundred-and-twentieth of the average wage or salary during the preceding five years for every year of non-contributory service. The contribution required from employés under the Act is 5 per cent. of the salary received, to which the local authority contributes an equal amount. The fund is established and administered by the local authority. In the event of an officer or servant leaving the employ of the local authority in order to take up a position with another authority having a scheme in operation, the former shall pay to the latter a transfer value ascertained in accordance with rules made by the Minister of Health, and the officer or servant thereby becomes entitled to the same rights with the latter as he possessed with the former. If an officer or servant loses his position owing to reduction of staff or similar contingency, he is entitled to receive from the fund a sum equal to all his contributions together with compound interest. If he voluntarily resigns or is dismissed for incapacity, he is entitled to the return of all his contributions. In the case of death before receiving a pension his contributions will be returned to his legal representatives with interest at 3 per cent. If death occurs whilst drawing his pension his legal representatives will be entitled to receive his total contributions, less the amount already received with interest. Provision is made for the grouping together of local authorities who have not a sufficient number of employés to enable them to establish a scheme of their own.

Contributory Schemes Considered Desirable.

One of the difficulties in getting schemes of superannuation established in a few corporations has been the fact that whilst the staff have been anxious to have a scheme the workmen have not. In this connection it is worthy of note that the Departmental Committee on Superannuation recommended that schemes should be made compulsory on local authorities for the staff but not for the workmen. It would be a good thing if legislation on the lines of the report were adopted as it would be the means of bringing all local authorities into line, and so far as electricity supply is concerned it would be an added incentive to company undertakers to institute schemes for their staffs comparable with those established under the Act of 1922. Some of the large companies have already recognised the need and have instituted schemes, but these cannot be said to be of a uniform character. Some of them are on a non-contributory basis and are subject to the grave disadvantage that there is no definite contract between the employés and the company whereby pensions become payable. This is a defect which attaches to most non-contributory schemes. As they are wholly voluntary on the part of the employers the latter usually reserve to themselves the right to terminate the scheme or to exercise entire freedom of action in the granting or withholding of pensions. Such schemes cannot give to the employé that feeling of security which a superannuation scheme is designed to provide. He can never be certain that his future is assured, and whilst he may go on hoping that he will be one of the fortunate ones to participate in the benefits, it does not always follow that his hopes will materialise. In one very large power company the scheme is in the nature of a death benefit scheme and provides for the payment to the personal representatives of each employé who has been in the service of the company for a continuous period of five years immediately prior to his death, of a death benefit equal to the average annual salary or wage during the last five years of his service with the company. The scheme is a contributory one and is compulsory on all new employés who are eligible to participate in it. There is a provision for the return of contributions in the event of an employé resigning from the company's employ.

A Power Company's Scheme.

A more satisfactory scheme has been instituted recently by another power company. It is a contributory one and membership is open to employés on the permanent staff over 18 and under 65 years of age. For the purposes of the scheme the employés are classified according to their salary or wage and the benefits and contributions vary according to these classes. The employés' weekly contributions vary from 1s. to 20s., and the annual pension payable from the age of 65 for each year of contribution varies from £1 to £20. In addition to this there is a life assurance payable at death varying according to the classifications from £100 to £800. Pensions commence to run and are payable by monthly instalments in advance on attainment of the age of 65 and continue to be paid throughout the life of the employé. The amount of the pension depends on the total sum secured by the combined contributions paid each year by the company and the employé.

One of the difficulties in establishing pension schemes is with regard to the position of the older employés. It has been got over in the case of this scheme by the company taking over the responsibility and providing that employés in the service of the company at the time of the establishment of the scheme and who remain with the company to pension age, will be entitled in respect of each completed year of service to a pension at one-half the rate allowed under the contributory scheme. In the event of an employé leaving the service of the company he can have the option of (1) a refund of all his own contributions, or (2) a pension commencing at the age of 65 for the amount which his own past contributions have secured, or (3) continuing his contributions and securing such a pension as his past and future contributions will purchase. The contributions by the company will secure that in the event of the death of an employé while in the service of the company, or after he has retired on pension, a life assurance benefit will be paid to his legal representatives. In addition to this, in the event of death before 65 the whole of his contributions will be payable to his legal representatives. In the event of an employé dying after he has become entitled to his pension, but before he has received an amount equal to his total contributions, the balance of his contributions will be paid to his legal representatives. In the event of total and permanent disablement of an employé while in the service of the company prior to the age of 60, he will be entitled to the sum which would otherwise have been payable under the life assurance section at death, such sum to be payable by monthly instalments. These disablement benefits are in addition to the pension benefits under the scheme.

The contributions of employés under the scheme rank for rebate of income tax. Benefits under this scheme are secured by a contract with a well-known assurance company. The scheme itself is a typical illustration of a form of activity which has been spreading during the last few years. Companies are not always desirous of shouldering the burdens of a superannuation scheme themselves and so they enter into an arrangement with a life assurance company. During the last few years several life assurance companies have come forward with staff pension schemes and have taken over the responsibility of superannuating the staff of power companies. The fact that the pensions are guaranteed by an assurance company of standing which relieves the power companies from any financial responsibility or trouble, renders the method very attractive, and it is to be hoped that it will be adopted more extensively.

Boiler-house Problems.

A Review of the Present Situation from the Standpoint of the Operating Engineer.

By W. H. FETHNEY, A.M.I.E.E., A.M.I.Mech.E.

MODERN power stations in this country are coming to be classified by the type of boiler-house plant installed, whether stoker fired or pulverised-fuel fired. The two systems have differing problems at the combustion chamber, but these finally converge into one urgent problem at the stack, that of cutting down nuisance to a minimum. The majority of power-house men with experience of both systems of boiler firing are agreed that the travelling-grate equipment using preheated air will give as high a boiler efficiency, under test conditions and with expert handling, as the powdered-coal-fired plant, but, under the usual operating conditions of varying output and light-load periods, the overall boiler-house efficiency with stoker firing is definitely lower than that of the pulverised-fuel boiler house.

There are various causes responsible for this. Most stoker-fired boilers have too much fan power; the firemen have plenty of draught at their command and are always tempted to use more than is necessary for good combustion in order to keep a clean chimney. There is also the problem of the unburnt carbon in the ash, a loss generally much greater in stoker-fired boiler houses than in those of the p.f. type, even where steps are taken to deal effectively with the riddlings. The latter are a nuisance and source of loss, no matter how they are treated, finding their way as they do into the wind-boxes of compartment-type stokers and being liable to catch fire under those grates that use hot forced draught.

A further cause of loss of efficiency is the necessity of steaming extra boilers in ample time to work them in for the rising load. Every shift engineer is familiar with the nursing required by a battery of banked boilers waiting to go in for the peak and the time-lag before they do useful work when once they are on load.

It is on this point of flexibility that the powdered-coal installation shows to such advantage, especially with the bin-and-feeder system, the boiler-house now approaching the turbine room in speed of response to load changes. This extreme flexibility has, of course, the disadvantage that it acts both ways. In the event of a fan or feeder-gear failure the boiler output is reduced immediately, as there is practically none of the residual heat in the combustion chamber which one has with stoker-fired boilers. The flexibility of the pulverised-fuel-fired boiler house is not gained at the expense of efficiency, as might be supposed. The firemen have no difficulty in maintaining correct combustion conditions under varying boiler outputs, and 15 to 16 per cent. CO_2 content at the combustion chamber outlet is the rule, without showing signs of either CO or smoke. At the station with which the writer is connected, optical smoke detectors of a simple pattern, equally effective at night as in daytime, are standard on all the boilers, and the firemen consult these as they do the draught indicators and CO_2 meters. This ease of control is less marked with boilers fired on the unit system with two or three mills per boiler, the tendency with this type of plant being to regulate the steaming by cutting a mill in or out as required.

Pulverised-fuel firing has a further big advantage over the stoker-fired plant in the struggle for high furnace efficiency, in that it can make use of highly preheated air without any detrimental effects from the furnace maintenance point of view. This cannot be said for travelling grates, for which 350 deg. F. seems to be the limiting temperature, although one of the London power houses has a boiler equipped with a Harrington stoker designed to operate with a preheated air temperature of 500 deg. F. This, however, is an exception, and generally the air temperature is kept down to a figure round about 300 deg. F. to prevent fusing of the grate links and trouble with the furnace refractories.

The much-advertised characteristic of p.f. firing of being able to burn poor classes of coal is rather a doubtful advantage from the operating engineer's point of view. Coal with a calorific value of 8,000 to 9,000 B.th.u. per lb. and an ash content of 15 to 20 per cent. can be burnt efficiently, of course, but when one considers the troubles it carries with it in the form of furnace slagging, "bird-nesting" of tubes, with the more frequent soot-blowing required in consequence, and the extra dust emission from the stacks, it is a debatable question whether it is worth while burning such coal. A further problem arising out of this point of high ash content is that of the disposal of the slurry or sludge from the wet ash pit which is common to all powdered-fuel instal-

lations. So far as the writer is aware there is no market for this product. The Americans appear to have found a use for it in small quantities for cleaning dirty condensers, but in this country the usual procedure is to pay to have it taken away and dumped on waste ground. In contrast with this the clinker from stoker-fired boilers has a ready sale.

Although the two methods of boiler firing have such different characteristics in operation, they have a common problem when the gases enter the stack, and that is, how to render the waste products innocuous. This matter of the discharge to atmosphere of dust, grit, and evil-smelling gases is becoming of great concern to power-house engineers in all countries, and the increasing concentration of large units in a few selected stations makes a solution of the problem urgent.

The solids discharged from a stoker-fired plant are fairly easily dealt with, as they are in the form of grit and can be caught by cyclones. The sulphur and other objectionable gases are apparently open to treatment by water, and in this connection all power-house men are looking forward with great interest to results from the gas-washing plant being installed at Battersea. The dust nuisance from pulverised-fuel stations is of a different nature to the above, however; the stack discharge is not grit, but a very fine flour, only a very small proportion of which is deposited in a cyclone unless the rate of flue-gas travel is reduced to an unreasonable extent. The most successful line of attack up to the present, and the one adopted by several large power houses in the U.S.A., appears to be the electrostatic deposition method, which requires a great amount of space for its installation, but is effective. The other method in use is the "wet" system in which the flue gas is conducted through spray chambers on its way to the stack, being slowed down sufficiently to give the water time to saturate the dust particles and throw them down to the sluicing trench as mud. A modification of this, consisting of hollow baffles supplied with a constant trickle of water and staggered in the path of the flue gas, is in operation at the Issy-les-Moulineaux power station in Paris.

The wet system is fairly effective provided the spray nozzles are fine enough to give a mist effect, but the problem usually is how to obtain the water for the sprays, and how to dispose of it when it has done its work. In a small power station the latter question is solved by the use of several settling ponds which are dug out in turn as the solid matter settles out and the water soaks away, but this method is too unwieldy for a big station. A solution to this problem is being tried out in one or two stations in this country, and promises good results. It consists, in essence, of a rotary filtering plant to deal with the slurry, returning clean water to the flue-gas sprays and discharging the semi-dry mud in an easily handled condition. This means that a fixed quantity of water, plus a small amount of make-up only, is required in the spray circuit.

The ideal method of dealing with the dust would be to catch it at the outlet of the boiler, or at the very latest at the air-heater outlet, in order to prevent the excessive wear which occurs on the runners of the induced-draught fans. These generally require re-blading every few months owing to the abrasive action of the flue dust. Experiments with baffles in the combustion chamber outlet, arranged to throw down the dust into hoppers, have been tried with some success, as have also various designs of induced-draught fans utilising centrifugal force to separate the dust from the gas.

All these "dry-catching" systems, however, even assuming them to be 100 per cent. efficient, which they certainly are not at present, have the common drawback of dealing only with the dust trouble, leaving the sulphur to look after itself. It would seem likely, therefore, that the wet method of catching the dust and washing the flue gas simultaneously will be the probable line taken in future power stations. It is rather amusing, though, to reflect that when pulverised-fuel firing was introduced into this country a few years ago, the question of "fly-dust," as the Americans call it, was airily dismissed as of no moment; we were told that if the boiler-house chimneys were only taken up high enough there would be nothing to worry about!

Electric Tubular Heating.

Its application to the storing and conditioning of cigars.

THE electric tubular system of heating is especially useful in circumstances which call for heat control sufficiently exact to ensure the maintenance of such pre-determined temperatures as special conditions may require, and one of its most interesting applications is in connection with the conditioning of cigars and maintaining them in a continuous state of perfection. The importation of cigars into this country is carried out on a large scale, and before they can be sold to the consumer a process of conditioning for a period of from 4 to 9 months, according to their size, is necessary. The process is carried out in conditioning rooms in which the cigars are ranged on batten shelves fixed round the walls, and care is taken to ensure the passage of air around each pile of boxes.

An example of an installation of this kind is that at the extensive cigar stores of Messrs. Mayor, Sworder & Co., London. "Magnet" tubular heaters are installed along the skirting board of the bulk stock room, fig. 1, where the cigars are stored after transfer from the conditioning chamber and are kept in a constant temperature of 60 deg. F. in all seasons. In the conditioning chamber immediately adjacent to the stock room an exactly similar arrangement of heaters operates to give a slightly increased temperature of 62 deg. F. The running costs of this reliable and efficient method of conditioning and keeping in perfect condition the susceptible contents of the store is negligible compared with their commercial value when released for public consumption.

A similar installation of tubular heaters is a distinctive feature of the cigar department of the stores of Messrs. Coopers, Ltd., Liverpool, where tubular heaters of the same

Fig. 1.—Tubular Heaters in Cigar Stores.

make are conveniently mounted on brackets along the floor skirting and a consistently even temperature is maintained whatever the climatic conditions may be outside. The loading of the heaters is the standard of 60 watts per foot.

For the storage of smaller quantities of cigars, for instance, on passenger liners, in shops or private houses, a patented type of cabinet equipped with a small "Magnet" tubular heater and thermostat, fig. 2, gives very satisfactory results. The heater is fixed in the base of the cabinet and flanked on either side by damping trays in order that the necessary degree of humidity, a very important factor in the satisfactory preservation of cigars, may be maintained. Adjustable vents are fitted in the base of the cabinet, so that the incoming fresh air can be properly regulated. To secure the even circulation of warmed air through the cabinet, the first shelf is solid and covered with asbestos sheeting, thus causing the air to rise through the side compartments and so to the cigars.

The temperature of these cigar cabinets is kept constant at whatever degree may be desirable, usually 60 deg. F.

Tubular systems of heating for industrial purposes during the last few years have made good progress, and their adoption for many purposes that are little heard of, except among those who may be directly interested, may be accepted as evidence of their practical advantages, both from an economical and utility standpoint. The low consumption of energy in relation to the special conditions required, perfect cleanliness negligible maintenance costs, and unfailing reliability are

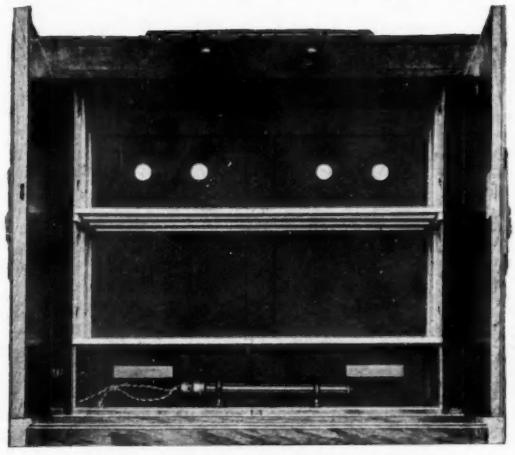

Fig. 2.—Interior of Cigar Cabinet.

features of the system which appeal in particular to cigar and tobacco importers, to whom the proper conditioning of their valuable merchandise is a matter of supreme importance

Parliamentary Notes.

(By Our Special Parliamentary Reporter.)

Parliament re-assembled after the Christmas recess on Tuesday, January 20th.

Minimum and Maximum Electricity Charges.

On January 21st MR. D. G. SOMERVILLE asked the Minister of Transport if he would state the minimum and maximum charges for light and power supplied in each area under the control of the Electricity Commissioners and the names of such areas.

MR. MORRISON said that he was not in a position to supply particulars of the charges made by each of the 660 or so authorised undertakers throughout the country which were subject to alterations from time to time within the authorised maxima. As regarded the London district, however, particulars of the various tariffs in operation were contained in the annual returns issued by the London and Home Counties Joint Electricity Authority.

Proposed Liverpool Street Tube.

On January 21st MAJOR NATHAN asked the Minister of Transport whether he proposed to take steps to secure the building of a tube railway from Liverpool Street *via* Bethnal Green to Ilford and beyond.

MR. MORRISON said he was informed by the London and North-Eastern Railway Company that it was not yet in a position to report any decision with regard to the construction of a tube railway from Liverpool Street to Ilford.

London Traffic Co-ordination.

On January 21st MR. OSWALD LEWIS asked the Minister of Transport when he proposed to introduce a Bill for the co-ordination of the tube railways, omnibus and tramways services of London.

MR. MORRISON said that discussions were still proceeding with the various authorities and bodies concerned, but he was not yet in a position to announce a date for the introduction of the Bill.

MR. LEWIS asked if the Minister had serious hopes of introducing the Bill in the present Session.

MR. MORRISON replied, "Certainly!"

The Brighton Transport Bill.

Consequent upon the recent rejection of the Bill by the Brighton ratepayers, formal notice has been given of the withdrawal of the Brighton, Hove and District Transport Bill. The Bill aimed at the co-ordination of the Brighton Corporation tramways and the district motor services owned by Messrs. Thomas Tilling under a board of five members.

Unemployment.

Replying to questions in the House of Commons last week, the Minister of Labour (Miss Bondfield) said that on schemes of a total value of approximately £77,000,000 sanctioned since June 1st, 1929, about 86,000 men were returned as directly employed on the various sites in mid-December last. The total of £77,000,000 included schemes to the value of about £26,000,000 under Part I of the Development Act, the employment value of which was preponderantly indirect. In addition, there were schemes to the value of about £10,000,000 approved by the Unemployment Grants Committee which were in operation but for which employment returns were not at present available.

On January 17th, 1931, the indebtedness of the Unemployment Fund was £62,980,000 and the unexhausted amount of authorised borrowing was £7,020,000. If the present rate of unemployment were to continue it was estimated that this balance would be exhausted during the first week in March.

The Trade Disputes Bill.

The debate on the second reading of the Trade Disputes and Trade Unions Amendment Bill commenced on Thursday last week and was continued this week. The Bill purports to restore the position with regard to the rights and liabilities of trade unions, &c., which existed before the Conservative Government's Act, which was passed as a consequence of the general strike of 1926.

Institution of Electrical Engineers.

Reports of the annual social functions of some of the Centres.

Western Centre.

The annual dinner of the Western Centre was held on January 19th at the Berkeley Cafe, Bristol, when MR. E. G. OKELL (chairman of the Centre) presided over a gathering of nearly 200, including ladies.

An addition to the programme was inserted at the beginning when the chairman presented to MR. C. T. ALLAN a silver tea and coffee service and a pair of silver-backed brushes in recognition of his 16 years service as honorary secretary. MR. C. T. ALLAN returned thanks in a humorous speech.

SIR ERNEST COOK, J.P., D.Sc., proposed the toast of "The Institution of Electrical Engineers," mentioning that the room in which the dinner was being held was built in what was once his own garden, where he had conducted experiments in the use of electricity for advancing the growth of plants.

MR. C. C. PATERSON, O.B.E. (president, I.E.E.), responding, said that apart from politics electricity was the chief factor in progress and the principal industry in the country, and the I.E.E. was responsible for the spirit that pervaded it, the ideals at which it aimed, and the character by which it was known to the world. The poisonous legacy of the Victorian era, the empiricism and ignorance of the hard-headed business man and the feudal overlord must no longer usurp the place in industry of scientific foresight, and there must also be a recognition of natural aspiration to share in responsibility. The electrical industry, which was less hampered by tradition than others, should be in the forefront of a movement towards a saner outlook. If the electrical industry attracted the best brains, and each one of its members did his share, it would be not only prosperous but great.

MR. W. J. BACHE proposed "The City and County of Bristol and the University of Bristol" in a felicitous speech which related the spirit of its old Merchant Venturers to its present position as a centre of industry and of technical education.

The toast was responded to by the Lord Mayor of Bristol (ALD. J. J. CLOTHIER) and PROFESSOR ANDREW ROBERTSON, D.Sc., the former referring to the docks, air-port, and industries of the city, and the latter to its academic achievements.

MR. S. B. HASLAM proposed the toast of "Kindred Societies and Guests," to which MISS CAROLINE HASLETT, C.B.E., and MR. J. H. ALPASS, M.P., replied.

The health of the chairman was proposed by MR. J. W. BEAUCHAMP. A vocal programme, in which songs in the dialect of the west country predominated, added to the enjoyment of a successful function. Comments on points in the speeches are made in our leading columns.

North-Western Centre.

The committee of the Centre gave its annual dinner on January 20th at the Midland Hotel, Manchester. The chairman of the Centre, MR. A. L. LUNN, presided, and about 300 members and guests were present.

MR. V. WATLINGTON, M.B.E. (chairman of B.E.A.M.A.) proposed the toast of "The Cities and Trades of Manchester and Salford." He said that Great Britain had, in becoming a great manufacturing and exporting nation, sacrificed agriculture. Now, however, other nations were determined to manufacture for themselves, for reasons more often psychological than economic. It was expected of the cities that they would take some characteristically bold steps to restore their prosperity, such as they took when they brought the sea to themselves by constructing the Ship Canal.

COUNCILLOR R. NORTON BARCLAY, J.P. (deputy mayor of Manchester), responding, referred to the paradox of the co-existence of excess of supplies and poverty, which he was convinced could be adjusted. He emphasised the importance of developing the smaller diversified trades of the district.

MR. F. PICK (managing director, London Underground Railways), proposing "The Institution of Electrical Engineers," referred to the growth of electrical output which in ten years had risen from 500 million to 12,000 million kWh. so that now the total consumption per head was about 400 kWh, but still greater strides in the increase of utilisation were necessary in this industrial country to enable it to compare in consumption with others. We could never get back to the old conditions, but we could shape our affairs to suit the new. Protected industries must do their share (*e.g.*, by cheapening power) and must pay regard to improvement in details, the effect of which would be cumulative, and thus become public services in every respect. He said that he had paid the greatest compliment within his power to Manchester in coming to it for an electrical engineer—their chairman, Mr. A. L. Lunn.

MR. C. C. PATERSON, O.B.E. (president, I.E.E.), responding, said that the prosperity of the electrical industry was due to good fortune, but in the future it must depend on merit. The grid, mass production, and improved commerce would not of themselves ensure Britain a foremost place among the nations if science were not brought into closer relationship with industry. (This speech is referred to in our leading columns.)

MR. A. L. LUNN (chairman), proposing the health of the guests, referred to the large number present (300), which constituted a record for the annual function. He addressed each of the principal guests by name, with appropriate references to their work. He also paid a tribute to the technical Press for its support of the I.E.E., and to the local daily Press for its interest in the Centre.

SIR JOHN BROOKE, C.B., responded, and referred to the possible adverse effect on the cost of electricity of eliminating sulphur from power-station emissions. It should be remembered that ultimately individual factory emissions would be merged into one.

A "surprise" item at the end of the programme was the appearance of the Minister of Transport (THE RT. HON. HERBERT MORRISON, P.C., M.P.), who contributed a speech as full of sound matter as it was of humour. He submitted that the Ministry of Transport, the Electricity Commissioners, and the C.E.B. should be regarded as a real part of the industry to help undertakings to do collectively what they could not do individually. He mentioned the lack of uniformity in voltages and frequency as very damaging to the goodwill of the industry, by which he meant the goodwill of the consumer towards the industry. The national need was for standardisation in certain matters, but that could not be brought about unless each undertaking knew that its neighbours would also comply with the general requirements.

North-Eastern Centre.

For the first time ladies were admitted to the annual dinner of the North-Eastern Centre at Newcastle-upon-Tyne on January 21st. A special toast was drunk to musical honours. A reception preceded the dinner, and a dance followed it, so that the whole character of the annual gathering was different from the thirty others that have been held. The chairman of the Centre, MR. B. H. LEESON, with MRS. LEESON, received the guests, who were able to meet also the president, MR. C. C. PATERSON and MRS. PATERSON. The toast list began, after the loyal toast had been honoured, with the proposal by MR. H. W. CLOTHIER of "The Lord Mayor and Corporation of Newcastle-upon-Tyne," to which the LORD MAYOR responded, remarking that the control of electricity supply in the city was likely to be one of the biggest responsibilities of the Corporation. It was coincidence that the City Council that night discussed whether it should take over the distribution in the city area.

The PRESIDENT, responding to MR. HERBERT SHAW'S toast of "The Institution of Electrical Engineers," pleaded for stronger co-operation between science and industry in electrical affairs.

MR. J. ROSEN proposed the toast of the "Ladies," to which MRS. C. PATERSON replied.

Tees-side Sub-Centre.

The Tees-side Sub-Centre of the Institution held its annual dance at Middlesbrough on January 16th. About 120 guests were present, representative of all the electrical firms in the district. Special features of the evening were the novel lighting effects, the arrangement of the switchboard being under the supervision of Mr. H. G. Stedman, of the Newcastle-upon-Tyne Electric Supply Co., Ltd., and Mr. D. B. Hogg, of the electrical department of Synthetic Ammonia & Nitrates, Ltd., the chairman and hon. secretary, respectively, of the Sub-Centre.

Dutch School Heating.

Holland is now heating public schools by electricity, and has made interesting experiments at Amsterdam with ceiling reflectors so arranged that the heat is distributed equally between the benches below. In other schools electric mats are used with success as regards heating, comfort, and better ventilation.

Reviews.

Electric Cables. By F. W. MAIN. Second edition. Pp. xii+115; figs. 35. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

This is one of Pitman's Technical Primers. The author has undertaken a big task in attempting "A Practical Treatise on the Construction, Properties, Installation, and Maintenance of Electric Cables" in a book of these dimensions. It should, however, serve as a useful introduction to the subject. Since the preface explains that the object is to provide fundamental technical information for the student and non-specialist, we think that the bibliography might with advantage have been extended and brought up-to-date. A striking omission from the short list of references given on page 111 is that of Mr. Dunsheath's book on High-Voltage Cables (reviewed in the ELECTRICAL REVIEW on December 13th, 1929) published by the same firm which is actually advertised elsewhere in this book. We would also point out that a good deal has been published on the subject of "Heating of Buried Cables" since 1923 (page 85). The book is well printed and illustrated and has a comprehensive index.

Radio-activity and Radio-active Substances. By J. CHADWICK. Third edition. Pp. xii+116; figs. 33. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

The main facts about radio-activity were so well established when the first edition of Dr. Chadwick's book was published ten years ago that the alterations required to bring it up-to-date have been effected without change of the plan or scope of the work. Subsequent researches have been very largely concerned with increasing the precision of earlier results, and with this has come a much more exact knowledge of the internal properties of the nucleus without any considerable revision of what had previously been known about it. The additions are concerned mainly with the evidence for quantization of the nucleus afforded by beta and gamma rays, and the anomalous scattering of alpha particles which penetrate very close to the nucleus and the artificial disintegrations which may occur if they pass inside, these subjects being outlined with about the same detail as the older sections. Dr. Chadwick also refers to the new quantum mechanics of the nucleus, which has given for the first time a satisfactory picture of the process of disintegration. The one direction in which this book could be improved is by the inclusion of photographs taken by the cloud method of Prof. C. T. R. Wilson, but we take it that this is impracticable if the price is not to be very materially raised. Dr. Chadwick's presentation of this subject, which he has himself done so much to develop, could hardly be bettered.

Testing Radio Sets. By J. H. REYNER, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E., M.Inst.R.E. Pp. vi+178; figs. 88. London: Chapman & Hall. Price 10s. 6d. net.

There is no doubt that in all testing operations it is of great advantage to proceed along well defined lines. Every experienced technician who sets out to locate a fault does so systematically along well defined lines, even if, as is likely, he does so quite unconsciously, and Mr. Reyner sets out in this book to put the inexperienced wireless technician on the same level, as far as possible, as his more experienced confrère. The book deals with broadcast receivers only, and it might have been better, we think, if this had been made clear in the title.

The first section, comprising two-thirds of the book, deals with the location of faults, the second section with laboratory tests, including an appendix on the testing of components. The latter section is intended primarily for designers and works' testers, and is a very wide field to attempt to cover in the space allotted to it. What it does cover is well done and should be of considerable value to the laboratory tester, but the first section is one that will have a much wider appeal, as it is intended primarily for the amateur experimenter and for those who carry out service work in connection with the sale and maintenance of broadcast receivers.

There has recently been rapid development in all-main broadcast receivers, and in the supersession of receivers of the component type by those of a more compact and more carefully screened design, a fact which makes it all the more necessary for retailers to be able to provide skilled service after sale. For this purpose the first section can be strongly recommended to the notice of retailers who must keep well abreast of the times if they are to see their sales advancing, and it can be just as strongly recommended to that large body of home experimenters. This first section deals lucidly and methodically with all the ordinary tests which may be required, and assumes the minimum amount of testing apparatus; in fact it does exactly what it should do, and we know of no other book that does it so well. The second section, as we have said, should be of value to a different class of experimenter, but the book will be chiefly valued for the first section which has such a far wider appeal. The production of the book is first-class.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations, and Failures.

The Argentine Electric Motor Market.

In a recent article upon the use of electric motive power in Argentina, *Commerce Reports* states that during 1929 there was an increase of 17.8 per cent. in the consumption of electrical energy for power purposes in Buenos Aires, as compared with about 12 per cent. in 1928. In the interior, although the use of electric power is much less developed, the consumption continues to expand. In 1929 the United States exported motors to the value of almost $1,000,000 to Argentina. During the past few years the importance of electric motor sales and the increase in installed capacity of generating equipment indicates that a change from steam and internal combustion driven engine-power units has been taking place at a rapid rate. While there is more or less demand for practically all of the sizes of motors in common use, the largest number of motors sold belong to the fractional horse-power class, especially those of about one-fourth horse-power and under, whereas with regard to value of the motors sold, the 1 to 200 h.p. class is of greatest importance. In the fractional h.p. motor market American manufacturers have the leading position, but in the sales of 3-phase a.c. and 440-V d.c. motors the field is dominated by German, Italian, and British firms because of the lower scale of prices applying to motors of their manufacture. European prices are said to be roughly about 20 per cent. lower than American prices. Since most of the tramway and railway companies are owned by British capital the purchases of mechanical equipment on these systems are generally made in London. Imports of British motors of types other than railway motors are usually made up of the sizes above 1 h.p. and are mostly of the a.c. class. There is said to be but small demand for British motors in fractional h.p. sizes. Exclusive representatives in the form of some well-known local firm are desirable and this representation should be placed with a firm handling machinery and allied lines since such firms have an opportunity to sell electric motors when they make sales of other classes of machinery. Also, whenever possible, organisations having technical or engineering sections should be sought, as such firms are very often called upon to design installations in which electric motors may be used.

Electrical Manufacture in the United States.

According to figures collected at the Census of Manufactures taken in 1930, the total value of electrical machinery, apparatus, and supplies produced in 1929 by establishments in the United States amounted to $2,323,597,927, an increase of 39.3 per cent. as compared with the $1,668,104,965 reported for 1927, the last preceding census year. The total for 1929 is made up as follows:—Insulated wire and cable, $296,858,831; motors, not including fan motors, $185,233,201; batteries, parts and supplies, $145,207,574; industrial, commercial, and domestic apparatus and appliances, $100,698,743; incandescent lamps, $85,319,515; switchboards, circuit breakers, and switches, $79,424,219; transformers, induction voltage regulators, and current-limiting reactors, $78,114,532; generating apparatus and parts, $68,131,815; ignition apparatus for internal combustion engines, $54,426,944; conduits and fittings, $46,915,073; wiring devices, $43,120,093; control apparatus, $42,451,032; measuring instruments, relays, and instrument transformers, $38,328,070; electro-therapeutic and electro-medical apparatus, $19,957,011; fuses and fuse blocks, $13,420,285; electric fans, $11,560,642; miscellaneous electrical equipment, $936,059,847.

Of the total, $2,217,634,994 was contributed by establishments engaged primarily in the manufacture of electrical machinery, apparatus, and supplies, and the remaining $105,962,933 represented the value of such commodities made as secondary products by establishments engaged primarily in other lines of manufacture.

Price Reductions.

The GENERAL ELECTRIC CO., LTD., announces a substantial reduction in the price of its "Gecophone" portable radio receivers.

We have received a folder from the STEEL BAND CONVEYOR AND ENGINEERING CO., LTD., Birmingham, containing particulars of reductions in the prices of the company"s steel conveyor band.

The Prevention of Accidents.

Industrial accidents cost the country over £20,000,000 every year, and in compensation alone over £6,000,000 is paid. It is claimed by the Accident Prevention and Welfare Publications, Ltd., that 80 per cent. of all accidents can be avoided by exercising due care. In the "Accident Prevention Calendar for 1931" will be found a comprehensive summary of the various accidents to be met with in everyday life with their causes and means of prevention. The text is compiled on attractive and clear lines and is not just an uninteresting list of rules and regulations. The calendar, with its 64 closely but clearly printed pages and numerous illustrations should prove a most valuable help to accident prevention propaganda. For single copies the price is 4d. net.

Films at the Buenos Aires Exhibition.

A Film Section has been arranged by the executive council of the British Empire Trade Exhibition at Buenos Aires. This will be under the management of the Commercial and Maritime Film Service in collaboration with the council of the Exhibition and the Educational Films Bureau. There will be a series of theatres distributed throughout the Exhibition so arranged that each film is shown in, or as near as possible to, its own section, and films are being shown strictly to a time schedule. An excellent response has been received to this offer of film facilities. Films entered already run to many thousands of feet dealing with a variety of subjects including the manufacture of various types of electrical apparatus, and both silent and talking equipment is being used. All-British machines of the latest type and British operators are being sent from this country. All the films have had their titles translated into Spanish and some into Portuguese. In the "talkie" versions Spanish will be the language used.

Electrical Exports and Imports: Volumes and Values.

The *Board of Trade Journal* publishes an analysis of Great Britain's overseas trade in 1930 in which volumes and values are compared with the 1924 figures. This shows that so far as electrical goods and apparatus were concerned exports during the past year were 122.8 per cent. in volume and 90.9 per cent. in average value of the 1924 figures. On the other hand the volume of imports was 277.5 per cent. of the 1924 volume, while the average value fell to 75.2 per cent. of the 1924 level.

Swedish Electrical Imports and Exports.

The imports of electrical machinery into Sweden during November last had a value of £144,910, bringing up the total for the first eleven months of the past year to £1,257,930, as compared with £968,820 in the corresponding period of 1929. The imports are small in comparison with the exports of Swedish electrical machinery, which in November last amounted to £341,895, making a total for the eleven months of £2,951,270, as compared with £2,712,415 in the corresponding period of the preceding year.

Wages in the Cable-making Industry.

The Joint Industrial Council for the Electrical Cable-making Industry informs us that there will be no "cost-of-living" alteration in wages in the industry on the third pay day in February.

Calendars, Diaries, &c.

A useful metal paper knife has been received from MR. CHARLES SELZ, 47-49, New Cavendish Street, W.1.

A humorous drawing based on the toughness of their paper appears on the 1931 calendar of Messrs. R. & W. WATSON, LTD., Linwood, Renfrewshire.

Radio Goods Exported by Air.

IMPERIAL AIRWAYS, LTD., in drawing attention to the advantages of sending goods by air, instead of by the usual methods, especially with regard to speed, pilfering and breakage, state that nearly two million radio valves have now been "shipped" from London to the Continent in their machines, as well as about £80,000 worth of loud-speakers.

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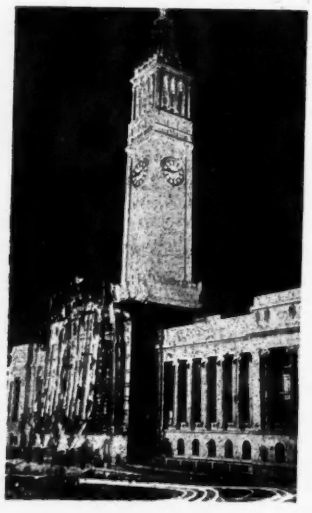
Proposed New Electricity Offices at Ashton.

Ashton Corporation Electricity Committee has under consideration a scheme for the erection of new administrative buildings for the electricity department, which has already been submitted to the Town Council but referred back for further attention. Exception has been taken to the proposal, because the Electricity Committee has selected a valuable central site which, it was stated at a Council meeting, would be quite suitable for a showroom, but was too expensive for offices, stores, &c.

Floodlighting Brisbane City Hall.

An effective floodlighting scheme for the tower of Brisbane's new City Hall, a night view of which we reproduce, has recently been carried out by Messrs. Norman Bell & Co., Ltd., of Brisbane. The tower is 300 ft. above street level and is illuminated by thirty-five floodlights equipped with Osram lamps. The illuminated ball which surmounts the tower is six feet in diameter and is visible at a distance of thirty miles. The floodlighting scheme is said to be one of the largest, of a permanent nature, which has been installed in Australia. Hitherto the imposing dimensions and stately contour of this tower could only be appreciated in the daytime, but now it stands out boldly against the night sky and can be discerned from a considerable distance from the city. We understand that this scheme has given a considerable fillip to the floodlighting of large buildings in the district.



Floodlighting Brisbane City Hall.

Unemployment.

There was a decrease of 27,762 in the number of registered unemployed during the week ended January 19th. At that date the total was 2,608,406, as compared with 2,636,168 on January 12th, and 1,473,402 on January 20th, 1930.

Employment During December.

The January *Ministry of Labour Gazette* says that employment in the engineering industry during December remained bad and declined still further in all sections, except in electrical engineering which reported a slight improvement. The total number of unemployed in the engineering industry as a whole increased from 204,631 to 222,048, and the proportion from 20.1 to 21.8 per cent. In the electrical engineering section the number fell from 10,232 to 10,012, reducing the proportion from 11.4 to 11.1 per cent. In the cable, wire and lamp manufacturing group there was a further increase—from 10,225 to 10,804—raising the proportion of unemployed from 10.0 to 10.5 per cent. There was also another rise of unemployment in the electrical wiring and contracting industry—from 2,025 to 2,321 (from 10.9 to 12.5 per cent.).

A Shannon Scheme Dispute.

It was stated last week in a *Reuter* message from Berlin that differences had arisen between the Irish Free State Government and the German Siemens concern regarding the payment of £750,000 for work carried out in connection with the Shannon hydro-electric scheme. *The Times* quotes a statement made by the company in which it is said: "It is generally known that the construction of the Shannon power works by the Siemens concern was an undertaking costing about £5,000,000. As usually happens on such vast and complicated undertakings, differences of opinion have arisen between the parties over a number of important questions connected with the liquidation of the contract. The negotiations for the settlement of these differences have not yet been carried far enough for a forecast of their final outcome to be possible."

Trade Announcements.

FRIGIDAIRE, LTD., has reconstructed and opened premises at 141, New Bond Street, W., as London showrooms.

We are asked by the AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD., to state that Mr. J. A. Poliakoff is not now connected with the company.

Messrs. R. M. CATTERSON-SMITH are removing to a new factory—Adam Bridge Works, Exhibition Grounds, Wembley, to-morrow (January 31st).

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., states that it can now supply Class P.B.J. insulated wires, to P.O. requirements, finished in green and chocolate brown in addition to the normal red finish.

For Sale.

Steam and petrol engine generators with battery, switchboard, &c., are offered for sale by the Birmingham Public Health Department.

Messrs. Leopold Farmer & Sons are selling a single-storey factory at Bristol.

The Southend-on-Sea Electricity Department invites tenders for the purchase of miscellaneous plant and material.

Harrogate Corporation has for disposal a 1,250-kW turbo-alternator, condenser, boilers, &c.

Brighton Electricity Department offers for sale a 600-h.p. steam turbine, d.c. generator, &c.

A quantity of electrical plant is being offered for sale by Messrs. E. S. White & Co., of Warrington.

(See our advertisement pages to-day.)

Recent Contracts.

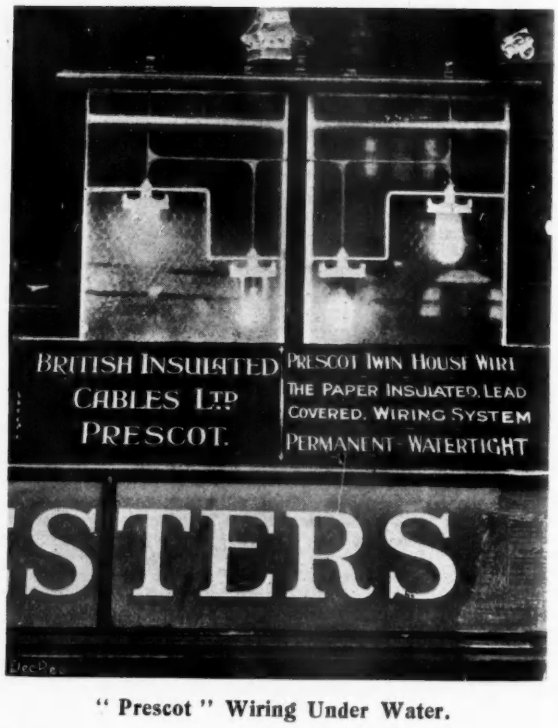
Messrs. BABCOCK & WILCOX, LTD., have received a contract for boiler plant, valued at about £700,000, from the County of London Electric Supply Co., Ltd. The plant is for the County Company's Barking extension.

The BRITISH CENTRAL ELECTRIC CO., LTD., 6 and 8, Rosebery Avenue, E.C.1, has supplied 128 electric lighting fittings for the new Drage building in Oxford Street, W. The fittings are of the "Cristalite" type made to the designs of Messrs. Drage's architects, Messrs. Gordon Jeeves and H. A. Welch. Fittings made from similar glass tubes have already been supplied by the company to the "Trocadero," and to the May Fair Hotel.

The ALTON BATTERY CO., LTD., Alton, Hants., has received a contract for the renewal of the positive plates in a battery of 6,440-Ah capacity at the Fisher Street sub-station and for the renewal of the positive plates in a 5,200-Ah battery at Tower Street sub-station of the Metropolitan Electric Supply Co., Ltd.

An Unusual Window Display.

Messrs. A. E. Chesters, of New Brighton, have recently been displaying in their window a novel exhibit comprising a glass tank containing lamps wired with B.I. Prescot twin house wire, the whole of the wiring and fittings being completely immersed in water. The appearance of the lamps burning under the water is very effective and has attracted considerable attention. The exhibit served to emphasise the waterproof properties of B.I. Prescot twin house wire.



"Prescot" Wiring Under Water.

The Birmingham Electric Club.

Mr. F. W. Martin (president) speaking on January 23rd at a meeting of the Birmingham Electric Club, referred to the amazing growth of electricity in industrial operations, and stated that to-day nearly all successful manufacturing concerns were electrically driven throughout. The use of electricity had enabled many industries to improve the quality of their products and reduce the cost to the consumer. In the chemical industry the progress made in the use of electricity had been

phenomenal, and industrial electric heating was making great strides. Agriculture was waking up to the fact that electricity might be of immense service, and the mining industry was employing more and more electrical machinery.

The E.D.A. Annual Meeting.

The annual general meeting of the British Electrical Development Association is to be held at the Savoy Hotel on March 20th at 3 p.m. It will be preceded by a luncheon at the hotel at 12.45 for 1 p.m.

Ferranti Works Extension.

Messrs. FERRANTI, LTD., intend to transfer their moulding department from Stalybridge to Hollinwood, and have acquired from the Oldham Corporation a plot of land adjoining the present works.

Bankruptcy Proceedings.

J. SAYER, electrical engineer, formerly of 177, Regent Street, and 53, Great Marlborough Street, W., present address unknown.—The statutory first meeting of creditors under this failure was held on January 22nd, at the London Bankruptcy Buildings. The receiving order was made on January 8th upon the petition of Johnson & Phillips, Ltd. The Official Receiver reported that the debtor had not attended under the receiving order. An inspector had visited both addresses and had reported that the debtor left some months ago and that no property, books or papers belonging to him were on the premises. The case was left in the hands of the Official Receiver.

W. P. BARNELL, electrical engineer, 25a, Sheep Street, Northampton.—Receiving order made January 19th on debtor's own petition.

[Messrs. W. P. Barnell & Co., Ltd., electrical engineers and contractors, of 6, Newland, Northampton, ask us to state that Mr. Barnell is not connected with their company.]

H. C. SCHOLES (Scholes Electric Co.), electrician, 72, High Street, Sidcup.—First meeting February 11th at the Official Receiver's office, 280a, High Street, Rochester. Public examination March 2nd at the Court House, Eastgate, Rochester.

A. C. E. APPLIN (Applin & Burt), electrical engineer, 110, St. Mary's Road, Southampton.—Receiving order made January 16th on debtor's own petition.

E. P. STURGEON, electrical engineer, 88, Northgate, Hartlepool.—First meeting January 30th at the Official Receiver's offices, 80, High Street, Stockton-on-Tees. Public examination February 5th at the Court House, Bridge Road, Stockton-on-Tees.

W. ADAMS (Electrovacs), electrical engineer, 120, Victoria Street, S.W.—Application for discharge to be heard on February 11th at Bankruptcy Buildings, Carey Street, W.C.

A. P. GODDARD, electrician, 25, Silver Street, Doncaster.—Last day for receiving proofs for dividend February 4th. Trustee, Mr. L. J. Clegg, 14, Figtree Lane, Sheffield, Official Receiver.

Company Liquidations.

J. PATERSON & CO., LTD.—A meeting of members will be held on February 20th at 49, Spring Gardens, Manchester, to receive an account of the winding up of the company by the liquidator, Mr. A. Broadbent.

STANDARD RADIO CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. Peet, 1, High Street, Croydon.

W. L. WHITE, SON & CO., LTD.—A meeting of members will be held on February 27th at 55, Temple Row, Birmingham, to receive an account of the winding up of the company by the liquidator, Mr. C. E. Cowney.

BATTERY PLATES, LTD.—Meetings of creditors and members are to be held at the offices of Messrs. Armstrong Lloyd & Co., 41, Corporation Street, Manchester, on February 24th to receive an account of the winding up of the company by the liquidator, Mr. E. M. Redhead.

Dissolutions of Partnership.

RAVENSHAW & DYER, consulting engineers, Carbon Chambers, Hall Gate, Doncaster.—Messrs. H. W. Ravenshaw and C. F. Dyer have dissolved partnership. Mr. Dyer will continue the business under the same style at the above address.

FARADAY RADIO CO., electrical and wireless engineers, 3a, Margravine Gardens, West Kensington, W.—Mr. T. E. Fevyer and Mr. G. A. Leckie have dissolved partnership. Mr. Leckie has retired from the firm.

Private Arrangements.

J. JOHNSON and J. A. PENNELL, trading as "Jack Johnson," 6, Cross Street, Willenhall, wireless dealers.—At a recent meeting of creditors, a statement of affairs was submitted which showed liabilities of £945 and net assets of £329, leaving a deficiency of £616. The debtors commenced trading in partnership in October, 1929. Johnson was stated to have had little or no capital at the time, but his partner introduced sums totalling £610. The debtor Pennell had carried on a separate business. It was not, however, estimated that there would be any surplus arising from his separate estate. A firm which had advanced money in respect of hire-purchase debts was a fully-secured creditor. The opinion was expressed that efforts should be made to sell the business as a going concern. A resolution was passed confirming the deed of assignment already executed to Mr. W. P. Barnfield, accountant, Walsall, and a committee of three of the principal creditors was appointed.

The Argentine Radio Market.

A message to *Reuter's Trade Service* from Buenos Aires says that notwithstanding general business depression and the partial embargo on imports of luxuries, sales of radio apparatus in Argentina have shown a distinct advance during the past year. Wireless apparatus, over 80 per cent. of which came from the United States, has been imported to the value of considerably over 2,000,000 gold pesos, compared with 1,578,650 in 1928. Receiving sets, capable of highly selective tuning, exceeded in value 50 per cent. of the total imports, and components were valued at over 250,000 pesos. The better market is attributed mainly to the improvement in broadcasting in Argentina. It is thought that if suitable British sets, that is with selectivity and range, were made available at competitive prices, much better business should result during the British Empire Trade Exhibition, leading perhaps to a permanent extension of trade. A much larger share of the trade could be secured by British firms were trouble taken in appointing agents and something spent on local advertising.

New Catalogues and Lists.

HERBERT MORRIS, LTD., Loughborough.—Booklet 705, giving full particulars of various types of "Morris" cranes. Also a leaflet dealing with electric hoists.

The EQUIPMENT & ENGINEERING CO., LTD., 2 and 3, Norfolk Street, Strand, W.C.2.—A folder describing the "E. & E." electro-magnetic crack detector.

CROMPTON PARKINSON, LTD., Guiseley, Leeds.—A folder entitled "Whose Motor?", indicating the merits of the "Crompton" motor.

HART ACCUMULATOR CO., LTD., Marshgate Lane, Stratford, London, E.15.—A folder entitled "Useful battery information for electric lighting contractors," giving in tabular form the details usually required in preliminary discussions with prospective battery users.

HICK, HARGREAVES & CO., LTD., Soho Iron Works, Bolton.—A brochure illustrating and describing the company's rotary compressors and vacuum pumps for air and gas.

The ENTERPRISE MANUFACTURING CO., 83, 85 and 87, Merton Road, Wimbledon, London, S.W.19.—A price list of electrical accessories.

The TUDOR ACCUMULATOR CO., LTD., 50, Grosvenor Gardens, Westminster, London, S.W.1.—Two attractively-produced publications relating to the "Safetylyte" system of emergency lighting for kinemas, hospitals, shops, &c.

The ELECTRO-MECHANICAL BRAKE CO., LTD., Moor Street, West Bromwich.—Catalogue E.201, dealing with "E.M.B." steel-case crane protective panels.

The DUBILIER CONDENSER CO. (1925), LTD., Ducon Works, Victoria Road, North Acton, London, W.3.—A two-coloured brochure issued in connection with the company's all-electric radio-gramophones and radio receivers.

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.—The January issue of the "Osram Bulletin" contains a number of interesting articles on the lighting of the new Trocadero kinema at the Elephant and Castle, Hastings promenade lighting, electrical progress in the South Midlands, new "Osram" power valves, flashers' interference with wireless reception, and shop-window lighting. Also an illustrated and priced catalogue (section C) of "Magnet" conduits and conduit fittings.

The MULLARD WIRELESS SERVICE CO., LTD., Mullard House, Charing Cross Road, London, W.C.2.—An interesting booklet, describing the "Mullard" public address van, and an attractive poster giving in tabular form the correct types of "Mullard" rectifier valves for use in a.c. mains apparatus.

The REVO ELECTRIC CO., LTD., Britannia Works, Tividale, Tipton, Staffs.—A catalogue giving a description and good illustrations of the "Revo" traffic-control apparatus.

The DRAYTON REGULATOR & INSTRUMENT CO., LTD., West Drayton, Middlesex.—A leaflet giving details of the "Drayton" sight glass for flow observations in pipe lines.

MAWDSLEY'S, LTD., Dursley, Glos.—A folder relating to Mawdsley motors and dynamos.

Social Events.

The third annual dinner of the Beckenham Electricity Undertaking Social Club was held on January 21st at the Railway Hotel, Beckenham. The guests include Mr. Jeff, chairman of the Electricity Committee, members of the committee, and Mr. J. E. Tapper, engineer and manager of the undertaking. Mr. Jeff, in proposing the toast of the Electricity Department, referred to the growth of the undertaking during the past four years, and said that the number of consumers in 1926 was 4,280, and in 1930 the total was 7,250, an increase of 70 per cent., with a consequent increase in electricity sold from 2,591,000 kWh to 6,187,000 kWh. There had also been a considerable increase in the use of cookers. Mr. Tapper responded, and said that the sympathetic and helpful attitude adopted by the Electricity Committee was largely responsible for the development and expansion of the electricity undertaking. The evening was concluded with a musical programme.

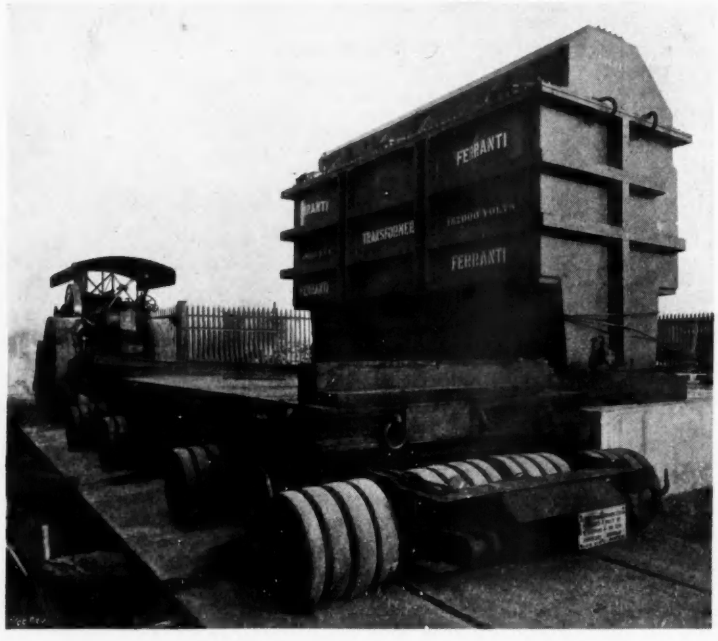
Over 1,500 employés of the Liverpool Corporation Tramways Department attended the annual ball held recently under the auspices of the Tramway Employés Social and Athletic Society. The function, which was held on two evenings, was attended by the chiefs of staff and members of the Liverpool City Council.

Cable Companies' Australian Branch.

The LIVERPOOL ELECTRIC CABLE CO., LTD., has appointed Mr. A. Maughan as manager of its Sydney (Australia) branch. Mr. Maughan will also represent the interests of the associated companies, the LONDON ELECTRIC WIRE CO. & SMITHS, LTD., and FREDERICK SMITH & Co., and large stocks of the products of all three companies, which include cables, flexibles, wires, bare conductors and "Lewcos" radio products, will continue to be carried. The address is "Lewcos House," 233, Clarence Street, Sydney, New South Wales.

A Ferranti "Super-Transformer."

We illustrate herewith a giant transformer which Messrs. FERRANTI, LTD., have supplied for the Deptford sub-station of the Central Electricity Board. It is capable of giving an



The 60,000-kVA Ferranti Transformer and its Carriage.

output of 60,000 kVA at 132,000 V, and it has a total weight of 93 tons. The transportation of the transformer from the railway to site naturally presented a special problem and the illustration shows the means adopted to meet this. The road vehicle employed had 32 pairs of wheels and was drawn by two traction engines. The loading of the transformer upon the vehicle was accomplished without the aid of a crane, hydraulic jacks being used. A historical note may be appended. It was at Deptford, forty years ago, that Dr. de Ferranti built the station which was the prototype of all modern generating stations.

A Commercial Guide to Spain.

The Department of Overseas Trade has added to its "Hints for Commercial Visitors" series a booklet prepared by the Commercial Secretary at Madrid dealing with Spain (Ref. No. C.3424). This contains advice as to the best time of the year to visit Spain on business and suggests the best way of getting there. The towns in which there is a likelihood of finding business are mentioned and the methods and cost of travelling are set out. The names of the principal hotels, together with an indication of their charges, and other items of probable expenditure are given. Other information includes regulations regarding commercial travellers and samples, climatic conditions, &c. The Department has also issued a guide for visitors to the Canary Islands (Ref. No. C.3433).

Book Notices.

"Electricity for Architects," by C. Holmes Waghorn (148 pp.; 63 figs.). London: Blackie & Son, Ltd. Price 6s. net.—It is agreed that one important means of expanding the use of electricity is to interest architects in the matter and to make them fully aware of the possibilities. It is necessary, moreover, to educate them, to enable them to distinguish adequate and sound installations from skimped and poor wiring. These are the purposes of the present work, and the matter, taken mainly from authoritative sources, carries out the intention very well. After a brief review of the subjects of the generation and distribution of electricity, the author makes a study of the various systems of wiring employed. He then deals with the inspection and testing of installations, specifying the character of cable and accessories which should be employed. Following this there are chapters on illumination (architectural, shops, public buildings, and domestic), the heating of buildings, hot-water supply, electric kitchens and electric refrigerators. An adequate index is provided.

"Rationalisation," by J. A. Bowie, M.A., D.Litt. (36 pp.) London: Sir Isaac Pitman & Sons, Ltd. Price 1s. net.—This book is comprised of a series of articles reprinted from *The Times Trade and Engineering Supplement*. Dr. Bowie deals dispassionately with the meaning of the word "rationalisation" and supplies the definition: "Conscious control and readjustment" as opposed to the automatic accommodation of an industry to changing conditions. The author discusses the mechanics of rationalisation, the planning of production, the effects upon employés, and the problems of control. The little work is a sound and concise treatise on this very prominent question of the day.

"Electricity, Magnetism and Electro-chemistry—Annual Tables of Constants and Numerical Data," by A. Buffat, L. Durand, G. Foex, R. L. Fortrat, N. Marmesco and N. Thon. Pp. xviii+136. Paris: Gauthier-Villars et Cie, 55, Quai des Grands-Augustins. Price 90 francs cloth, 80 francs, paper.—This is the seventh volume of this most useful publication and is compiled from data relating to the years 1925-26. Both French and English are used throughout, with occasional references in German and Italian. Among the subjects covered are resistivity, thermo-electric forces, insulators, dielectric constants, ferro-magnetism, atomic moments, magneto-chemistry, electrical conductivity of electrolytes, and electromotive forces.

"Report of the 98th Meeting of the British Association for the Advancement of Science, Bristol, 1930." London: The Association. Price 25s. net.—This combines in one cover the Council's report, the general treasurer's account, &c., Prof. F. O. Bower's presidential address, the addresses of the sectional presidents, sectional transactions and discussions, reports of the evening discourses, and several other matters.

"Theory and Electrical Drive of the Loom," by R. H. Wilmot. Pp. vi+144; figs. 27. London: Sir Isaac Pitman & Sons, Ltd. Price 8s. 6d. net.

The South American Journal, Vol. cix, No. 4, January 21st, 1931. Price 1s.—This number of the *Journal* (whose secondary title is "Brazil and River Plate Mail") is an interesting review of financial and commercial conditions in the South American countries during the past year. Although there is little or nothing regarding electrical trade, the issue contains a great deal of matter which should be of guidance to electrical manufacturers in their study of the market.

We have received from the Hackbridge Electric Construction Co., Ltd., a reprint from the ELECTRICAL REVIEW entitled "Difficult Transport," describing how 20,000-kVA transformers and other heavy electrical gear were hauled over the Highlands of Scotland.

"The *Engineer* Directory and Buyers' Guide, 1931." Pp. 260. This publication is issued to advertisers in the *Engineer*, and contains alphabetical lists of advertisers, their telephone numbers and telegraphic addresses. A list of B.E.S.A. publications is also included, as well as a useful foreign buyers' guide, giving translations in French, German, Italian and Spanish of the technical terms used in the directory.

Italian Foreign Electrical Trade.

Official returns just to hand show that the imports of electrical machinery, apparatus, and fittings into Italy during the ten months ended with October last attained a value of £3,026,625, as compared with £3,021,975 in the corresponding ten months of 1929. The exports of similar materials of Italian manufacture during the same periods declined from £771,585 to £766,275.

Prices of Materials.

Messrs. F. Smith & Co. report, January 27th: Copper (electrolytic) bars: £47 15s., £2 2s. 6d. dec.; ditto ditto sheets, no change; ditto ditto wire rods: £57 15s., £2 2s. 6d. dec.; ditto ditto i.c. wire: 7¼d., ¼d. dec.

Messrs. Edward Till & Co. report, January 27th: India-rubber, Para fine: no change.

Messrs. James & Shakespeare report, January 27th: Copper bars, best selected, sheet and rod: no change. English pig lead: £14 15s., 10s. dec.

Messrs. James Forster & Co., reporting on January 24th, stated that the lead market was dull and uninteresting last week, prices sagging daily and closing at the lowest. Outside conditions remain unchanged, demand from consumers being extremely dull with plentiful supplies arriving. Although prices are low it is difficult to find any "bullish" factor in the position; the only remedy is an all round curtailment of production, failing which prices will go to lower levels.

Lighting and Power Notes.

Alresford.—OVERHEAD LINES.—The Rural District Council has approved the erection by the West Hampshire Electricity Co., Ltd., of overhead h.p. and l.p. lines for the supply of electricity in the Council's area.

Australia.—THE WESTERN AUSTRALIAN GOVERNMENT UNDERTAKING.—In his report on the working of the Government electricity undertaking during the year ended June 30th last Mr. E. A. Evans, the Commissioner of Railways, states that the total revenue amounted to £304,015, as compared with £278,886 in the previous year, while the working expenditure was £227,654, as against £214,529. The gross profit rose from £61,357 to £76,361. Interest charges absorbed £59,492, leaving a net profit of £16,869, which compares with £7,703 in 1928-29. During the year £42,601 was spent on capital account, bringing the total now spent on the undertaking to £1,253,311. Electrical energy sold increased from 68,539,228 to 76,138,881 kWh and the maximum demand from 20,000 to 21,500 kW. The average price obtained per kWh declined from 0.97d. to 0.95d. The distribution system was extended in areas previously supplied but no extensive developments took place. A number of applications for supplies were received but owing to financial reasons some had to be held up.

ELECTRICAL DEVELOPMENTS IN VICTORIA.—Included among schemes introduced in the Legislative Assembly is one for the expenditure of £1,160,000 on electrical development. It is proposed to allocate this sum as follows:—Supply to country districts already served (including service extensions), £161,000; central supply system, £41,000; Yallourn open-cut workings, £170,000; Yallourn briquetting factory, £78,000; Yallourn "B" power station, £664,000; Richmond terminal station, £23,000; advances to the Electric Supply Company of Victoria, Ltd. (following the purchase of electrical undertakings at Ballarat and Bendigo), £23,000.

Aylesbury.—LOAN SANCTIONED.—The Urban District Council has received sanction to a loan of £3,000 for meters.

Bedford.—YEAR'S WORKING.—We have received from Mr. R. W. L. Phillips, borough electrical engineer, a copy of the accounts of the Electricity Department for the year ended March 31st last. The total revenue showed an increase from £109,429 to £122,483, while the working expenses amounted to £69,796, as compared with £56,974. There was a gross profit of £52,687 (£52,455), to which was added £205 interest from sinking fund investments, and £2,773 unemployment relief grants, making a total of £55,666 available. After providing for capital and other charges there was a net deficit of £331, as compared with a net surplus of £3,605 in 1928-29. During the year the capital expenditure amounted to £83,126, the chief items being £30,791 for mains and £19,578 for grid interconnector and switch house. The electrical energy sold rose from 16,807,521 to 26,658,177 kWh, the bulk supply sales showing an increase of 7,884,240 kWh. The maximum supply demanded increased from 7,150 to 9,250 kW.

Brighton.—COMPLETION OF RING MAIN.—The Corporation Electricity Committee is to complete the ring main from Woodingdean to Telscombe at a cost of £3,000.

Bromley (Kent).—CHANGE-OVER.—The Town Council has adopted a recommendation by the borough electrical engineer for changing the system of supply in the centre of the town from d.c. to a.c. at an estimated cost of £7,467, and the taking of a total bulk supply. Subject to the approval of the Electricity Commissioners the preliminary work is to be commenced at once with a view to the complete change-over being finished during the coming summer.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—In a review of the hydro-electric development in Canada issued recently by the Department of the Interior, it is stated that new installations totalling 397,850 h.p. were brought into operation during 1930, thus bringing the total installation of the Dominion at the end of the year to 6,125,000 h.p. Several large schemes are also in hand and over 1,500,000 h.p. will be added to Canada's electrical generating capacity during the next two or three years. During 1930 construction work cost about $80,000,000 and approximately $300,000,000 will be required for development schemes during the next few years.

Caterham (Surrey).—PROTEST AGAINST CHARGES.—A public meeting held recently at Caterham passed a resolution protesting against the prices charged for electricity by the Urban Electric Supply Co., Ltd. The Urban District Council has been asked to inquire from the company what reduction it is prepared to make voluntarily, and, if an unsatisfactory reply is received, to take steps to secure a Ministry of Transport inquiry.

Coatbridge. — FUTURE ELECTRICITY SUPPLY. — The Town Council is considering offers by the Coatbridge and Airdrie Electric Supply Co., Ltd., and the Clyde Valley Electrical Power Co. for the future supply of electricity.

Congleton.—MAINS EXTENSIONS.—The Town Council has decided to extend the mains to additional areas in the borough at a cost of £4,536.

Continental.—FRANCE.—The Société Lozerienne d'Energie Electrique, of Cheyland, Ardeche, has recently secured a concession to establish a plant to utilise the water power of certain falls on the River Lot, near Chadenet, in the Department of Lozère.

BELGIUM.—What are claimed to be the two largest centrifugal boiler-feed pumps in the world have recently been completed by Sulzer Gebruder, of Winterthur, Switzerland, for the central electric power station at Langerbrugge, near Ghent. Each pump is capable of delivering about 135 tons of hot water (temperature 180 deg. C.) per hour at a pressure of 250 atmospheres.

RUSSIA.—Reports have been received of the commencement of building operations at three large power stations which will form part of the general scheme for electrifying the country adopted ten years ago. At Voroniezh, in central Russia, the construction of a 48,000-kW station has been begun to supply power to local industries and the laying of the foundation stone of a 100,000-kW station is reported from Novossibirsk, the prosperous and rapidly growing capital of Western Siberia. Among the factories utilising the power from this station will be the great combine harvester plant under construction near the town. It is also announced from Verkhneudinsk, the principal town of the Buriato-Mongolian Republic, that work on a power station has just begun there to supply all the factories in the region. An appropriation of 850 million roubles (£85,000,000) is being made this year for electrification purposes.—*Reuter's Trade Service* (Moscow).

Coventry. — GENERATING STATION EXTENSION. — The City Council has applied for sanction to a loan of £3,218 for new plant for the Longford generating station.

Croft.—OVERHEAD LINES.—The Rural District Council has received sanction from the Ministry of Transport to the erection of overhead lines in the parishes of Dalton and Eryholme.

Croydon.—EXTENSION OF HIRE-PURCHASE SCHEME.—The revision and extension of the hire-purchase wiring scheme is recommended by the Corporation Electricity Committee.

LOANS.—Application is to be made for sanction to the loans required as follows:—£21,600 for mains and services, £20,000 for wiring, and £1,100 for public lighting mains.

NEW SWITCHGEAR.—The Electricity Committee recommends that orders should be placed towards the end of this year for new switchgear to replace existing sub-station switchgear in time for the heavier load of 1932. The estimated cost of making this alteration is £4,420.

EXTENSIONS.—An expenditure of £181,500 on plant, buildings, mains, &c., during the next twelve months is also recommended by the Electricity Committee.

Derby.—ASSISTED WIRING.—The Electricity Committee is considering the adoption of a scheme for assisted wiring for small houses.

EXTENSIONS.—In the next financial year the Electricity Co. proposes to spend a total of £79,200 on extensions, including £40,000 for mains and services, £10,000 for meters, £10,000 for transformers, and £10,000 for the wiring of 1,000 houses.

Glasgow.—PROGRESS DURING DECEMBER.—Under the Corporation Electricity Department's scheme for the wiring of houses 941 houses were dealt with in December, making a total of 28,719. Appliances let out on hire numbered 288, bringing the total to 21,016.

MAINS EXTENSIONS.—The Corporation Electricity Committee recommends the laying of distributing mains at a cost of £2,697.

ELECTRICITY FOR "ALL-GAS" HOUSES.—The Corporation Housing Department recommends the introduction of electric lighting in "all-gas" houses.

Hull.—ELECTRIC HEATING FOR SCHOOLS.—At a recent meeting of the Finance and General Purposes Sub-Committee of the Corporation Education Committee a report by its surveyor was considered relating to the use of electricity for heating in schools. The report embodied opinions of the city architect and the city electrical engineer, who recommended that, as an experiment, one new school should be electrically equipped for heating, and this was agreed to.

India.—HYDRO-ELECTRIC SCHEME.—Estimates are being prepared by the Cochin Legislative Council for the carrying out of the Poringalkutta hydro-electric scheme.

Llandrindod Wells.—PROPOSED EXTENSIONS.—The Urban District Council has declined to sell its electricity undertaking to the Shropshire, Worcestershire and Staffordshire Electric Power Co. and has decided to apply for permission to extend the generating station.

London.—SHOREDITCH.—The Borough Council Electricity Committee recommends the introduction of a revised sliding scale of charges for consumers using 25,000 kWh or more per annum for lighting. The proposed charges range from 3.9d. per kWh for 25,000 kWh to 2.5d. per kWh for 165,000 kWh and over.

POPLAR.—The Borough Council is considering the question of establishing an installation department in connection with the electricity undertaking. The Electricity Committee is to prepare a scheme on the understanding that it will be in the nature of a trial for the first twelve months.

HAMMERSMITH.—The Borough Council Electricity Committee recommends the following extensions:—Additional supply to Messrs. Fullers, Ltd., £2,160; additional supply to Messrs. Waring & Gillow, Ltd., £1,660; other extensions, £1,307. The committee also proposes that 1½-gal. electric water-heaters should be let out on hire at a charge of 5s. a quarter.

Lowestoft.—OVERHEAD LINES.—The Corporation Electricity Committee has obtained the consent of the Ministry of Transport to the erection of overhead lines in the parish of Pakefield.

PUBLIC LIGHTING FOR KESSINGLAND.—Terms have been approved by the Electricity Committee for installing a system of public lighting at Kessingland.

CHANGE-OVER.—Sanction has been received to the borrowing of £5,228 for the change-over of the system of supply in the Oulton Broad area.

LOANS.—The Town Council is to apply for sanction to loans of £5,000 for mains, £5,000 for meters, and £5,000 for services.

Melton Mowbray.—OVERHEAD LINES.—The Ministry of Transport has approved the erection of overhead lines for the transmission of electricity on the Scalford Road.

Newbury.—PROPOSED LIGHTING OF MUSEUM.—The Corporation Museum Committee is to consider the question of installing artificial lighting in the museum.

North Wales and South Cheshire Joint Electricity Authority.—SUPPLY PROGRESS.—According to information supplied at the quarterly meeting of the Authority, the new Maentwrog power station last year generated 31,000 000 kWh. of electrical energy, and the stations at Cwm Dilyn and Dolgarrog 54,000,000 kWh. Thirty-three miles of h.p. transmission line and underground cable were put into service, and it was stated that the company was working on another scheme, costing about £200 000 to meet the needs of the remaining district in the North Wales area.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

BATLEY.—Lighting flat rate: From 4½d. to 4d. per kWh. Sliding scale: A reduction of 10 per cent. Power and heating: A reduction of 5 per cent.

CROYDON.—"All-in" domestic tariff: The institution of a new class with a standing charge of £2 6s. instead of £2 16s., with a corresponding reduction to consumers on the two-rate system for Council houses; also a reduction of the "unit" charge in the summer months from 0.675d. to 0.5d. "All-in" business tariff: "Unit" charge reduced from 0.675d. to 0.5d.

PADIHAM.—Lighting for consumers of 500 kWh and over, per quarter: From 6d. to 4d. per kWh.

Scarborough.—YEAR'S WORKING.—The accounts of the Corporation Electricity Department for the year ended March 31st last showed a gross profit of £27.569. After debiting loan charges, there was a net loss of £1,106. The number of consumers increased by 603 during the year, making a total of 3,965.

South Africa.—PAARL.—The ratepayers of Paarl have given their sanction to the proposal of the Town Council to raise a loan of £70,000 for the erection of a power station and the provision of plant for supplying electricity to the town.

Southend-on-Sea.—THE GRID SUPPLY.—The Town Council has been assured by the Central Electricity Board that a direct supply of electricity will be available to the Corporation by October 1st next, and has decided to terminate the existing agreement with the County of London Electric Supply Co., Ltd., as from September 30th next.

Swansea.—SUPPLY TO HOUSING ESTATES.—The Corporation Housing Committee has decided to supply electricity under the terms of the assisted wiring scheme to those tenants of Corporation houses on the Birchgrove and other sites who require supplies.

United States.—THE MUSCLE SHOALS SCHEME.—*Power* states that an unexpected change of position by one of the House conferees has broken the long deadlock that has existed on Muscle Shoals legislation. An agreement was virtually reached when House conferees accepted the Senate's proposal to allow the Government to construct and operate transmission lines out of the profits from the sale of power. Details relating to the leasing provisions for the fertiliser plants at Muscle Shoals remain to be adjusted by the Senate and House conferees, but it is expected that these can be worked out without difficulty.

Withernsea.—STREET LIGHTING.—The Urban District Council has decided to substitute electric lighting for gas on the Promenade and in the principal streets of the town.

York.—PLANT REQUIRED.—The Corporation Electricity Committee recommends that application should be made for sanction to the borrowing of £1,457 for a duplicate transformer and £600 for connecting cables for the transformers and controlling switchgear. A further recommendation is for the purchase of chlorinating plant to deal with the condensing water of the two 6,000 kW turbines at the Foss Islands power station at a cost of £500.

Tramway and Railway Notes.

Australia.—THE WESTERN AUSTRALIAN GOVERNMENT UNDERTAKING.—The report of Mr. E. A. Evans, the Commissioner of Railways, shows that for the year ended June 30th last the total revenue of the Government tramway undertaking amounted to £349,270, which compares with £342,788 in 1928-29. Working expenses totalled £294.471, as against £281,257, leaving a gross profit of £54,799 (£61,531). After providing for capital and other charges there was a net profit of £3,277, as compared with £11,376 in the preceding year. The capital expenditure during the year amounted to £24,805, bringing the total now spent on the undertaking to £1,094,157. The number of passengers carried increased from 35,031,734 to 35,565,867, and the car mileage from 3,345,929 to 3,604,827. The average receipts per car mile were 23.25d., as against 24.59d.

Bournemouth.—RAILLESS CARS.—A report prepared by the members of the Corporation who were appointed to inspect the railless-car system of Wolverhampton states that the impression formed by practically all of the members of the party was that the railless-car was more silent and that there was less vibration and more even acceleration than with a 'bus. There was less noise than in the case of petrol vehicles, and the absence of smell and fumes was very noticeable. The ease with which the railless car can negotiate and pass other vehicles on the road and draw into the kerb is also commented on. The Tramways Committee is to hold a special meeting to consider the report and make recommendations.

Continental.—NORWAY.—According to a statement issued by Mr. E. Heiberg, general director of the Norwegian State Railways, the lines which have so far been electrified are those of the Tinnos railway, the sections between Oslo and Drammen, between Narvik and the Swedish frontier, Oslo and Lillestrom, Drammen and Kongsberg, and the goods line between Oslo, Alnabru and the Loenga sidings station. These lines form about 142 miles (or a fourth) of the country's wide-gauge system. The position of the State finances and the high level of prices have hitherto prevented the introduction of schemes requiring large grants, but plans and estimates have recently been brought forward for continuing the work of electrification from Kongsberg to Notodden and further to Skien and Borgestad. There is also scheme for the conversion of the Ostfold railway section between Oslo and Ski in connection with the prolongation of the line's double track from Ljan to Kolbotn, which is a necessary condition for the utilisation of electrical working. Both these lines will use the power from the Hakavik electricity works and the conditions are such that they will probably be carried out as soon as the necessary funds can be provided. Plans and estimates are also in course of preparation for the conversion of the whole of the remainder of the Ostfold railway.

SWEDEN.—As anticipated, the materials to be used for the electrification of the Stockholm-Malmoe line and the junction lines will be practically all of Swedish manufacture. The Railway Board has already concluded preliminary agreements with several Swedish enterprises, including the A.S.E.A., the Svenska Metallverken, the Finspongs Metallverk, and Elektromekano, of Haelsingborg, for the supply of electric locomotives, transformer stations and circuit wire.—*Reuter's Trade Service* (Stockholm).

FRANCE.—The ceremony of handing over to the Compagnie du Metropolitain the Porte de Charenton-Ledru-Rollin section of Line No. 8 has been performed by the company's director of technical services. This line, which runs under the boulevards, is to be completed in time for the Colonial Exhibition, and the company has made all arrangements to ensure the opening early in May. The substructure is almost completed between the Richelieu-Drouot crossing and the Chaligny station, except towards the Boulevard Saint-Denis, where the work is particularly extensive, and at the Bastille, where the tunnel passes under the Saint-Martin Canal.—*Reuter's Trade Service* (Paris).

Farnworth.—RAILLESS CARS.—A proposal by the Lancashire United Transport and Power Co., Ltd., to substitute railless cars for tramcars in the district has been agreed to by the Urban District Council.

Glasgow.—SUBWAY ELECTRIFICATION SCHEMES.—The Municipal Transport Committee has remitted to a sub-committee the consideration of schemes for the subway, including electrification, its extension as an electric railway, or the modernisation of the present system.

Japan.—EXTENSION OF ELECTRIC RAILWAY.—The Musashi Central Electricity Railway is considering a scheme for the extension of its system for a distance of 26 miles from Hachioji to Iino.

London.—UNDERGROUND HOLD-UP.—The failure of the electricity supply from Lots Road power station at 6.40 p.m. on January 22nd caused a suspension of the Underground railway services for about forty minutes.

Luton.—SALE OF TRAMWAY UNDERTAKING.—The Town Council has decided to sell the goodwill of the Corporation tramways to the Eastern National Omnibus Co., Ltd. The Council is to receive a sum of £64,000 and expects to have a surplus of over £57,000 after meeting all liabilities. The tramways are to be scrapped.

Manchuria. — DIESEL-ELECTRIC LOCOMOTIVE. — Trials have lately been carried out in Switzerland with a new Diesel-electric locomotive, jointly built by the Swiss Industry Co., of Neuhausen, and Sulzer Gebruder, Winterthur, for the Southern Manchurian Railways. The engine is intended for use at the port of Dairen, can haul a load of 1,800 tons at a speed of 15 m.p.h., and can travel at 40 m.p.h. with the load reduced in proportion. The motive power is supplied by a Sulzer-Diesel eight-cylinder engine of the airless fuel-injection type and is capable of developing up to 850 h.p. The engine is directly-coupled to a d.c. generator which supplies the power for four electric motors mounted on the four-wheel bogies. The fuel feed, lubrication, and water cooling are all automatically effected, enabling the locomotive to be attended by only one man. There is a driver's cab at each end of the machine from which the engine, which is mounted in the centre of the frame, can be readily started and stopped when the locomotive is running downhill or during stops at a station.

Southern Railway.—RAILWAY ELECTRIFICATION.—Included in the company's extensive programme of development and improvement for 1931 are plans for the completion of the major portion of the electrification extensions to Reigate and Brighton and West Worthing, involving over 50 miles of track. It is expected that the section from Coulsdon to Three Bridges will be ready for electric services by the end of the year. Additional electric train equipment for strengthening suburban services, including the conversion of existing rolling stock, will probably cost about £236,700.

Train Lighting.—AUTOMATIC CONTROL.—As an experiment, the L.N.E.R. Company is running for extended trials a vehicle on the King's Cross-Hull service in which the lamps are automatically controlled. Special fittings have been supplied by Radiovisor Parent, Ltd., to the requirements of Mr. H. N. Gresley, chief mechanical engineer of the company, says *The Times*. The apparatus is an attachment to the ordinary train lighting equipment, adjusted so that when the light outside the vehicle renders reading difficult the relay operates and the lights in the vehicle are automatically switched on. The reverse procedure takes place when the external light becomes strong enough. The apparatus thus functions not only during the hours of natural darkness, but also when the train passes through tunnels, below station roofs, and under long bridges.

Telegraph and Telephone Notes.

Australia.—TASMANIA.—Mr. H. B. Browne, director-general of the Australian Postal Services, giving evidence before the Public Works Committee which is investigating the proposed telephone service to Tasmania, said that the Postal Department preferred the submarine cable to wireless. It gave greater secrecy, more continuous service, and was the system by which the whole of the telephone needs of Tasmania could best be met. One wireless channel of communication would not be sufficient in the first year.

Canary Islands.—RADIO-TELEPHONY.—A direct telephone service was officially opened on January 22nd between Spain and the islands of Teneriffe and Gran Canaria. The service is conducted through the short-wave radio stations of the Spanish National Telephone Company at Madrid and Teneriffe, and the two islands are linked by submarine cable and overhead line. This new facility enables the fruit growing and shipping interests in the Canary Islands to establish direct contact with the fruit markets of England, France, Belgium, and Germany.

Egypt.—WIRELESS TELEPHONY.—Mr. F. G. Kellaway, vice-chairman and managing director of the Marconi Wireless Telegraph Co., has left Cairo for London, after discussing with the Minister of Communications, Tewfik Doss Pasha, the question of wireless telephony.

It is understood that the Marconi Company of Egypt will receive a concession for wireless telephony between Egypt and other countries.

According to *Reuter's* agency the Minister of Communications urged Mr. Kellaway to reduce his offer to the level of the French offer, namely, 347 piastres for a three-minutes' conversation (£1=97½ piastres). The Egyptian Government experts originally recommended the Marconi offer despite the fact that it was not the lowest. Wireless telegraphy, telephony, broadcasting, and airways were connected as British imperial communications under the Declaration of 1922 and that the Egyptian Government before granting concessions in this matter must secure British consent.

France.—TELEPHONE DEVELOPMENT.—Extensive improvements in the telephone system were outlined by M. George Bonnet, Minister of Posts and Telegraphs, at a luncheon given by the National Association of Telephone Subscribers. The development of telephone communication with the French colonies was one of the principal features dwelt upon, and the automatic system, M. Bonnett said, was gradually being installed in Paris, where 42,000 subscribers out of a total of 185,000 already had their telephones equipped with automatic dials. That improvement was begun in 1927, and some 60,000 lines per annum would be converted henceforward until by 1937 automatic service would be general throughout Paris. The conversion would thus take only ten years; in London a period of twelve years was envisaged, and in Berlin, where the installation of automatic telephones was begun before that of Paris, it would not be completed before 1940. Some 5,000 rural subscribers were already equipped with automatic telephones, which were of particular value in the country where exchanges were shut down in the evenings and on Sundays. By 1932 France would be linked by telephone with Algeria, and in the next Budget a credit of 102 million francs would be included for services to Corsica and Tunis, and to certain French colonies, including Western Africa and Madagascar, Syria, the Somali Coast, and Egypt. It was further proposed to erect a wireless station on the Atlantic coast which would ensure a telephone communication, up to 1,250 miles, with ships at sea. Lastly, a powerful new wireless station would enable the French colonies to hear with ease programmes from France.—*Reuter* (Paris)

Greece.—TELEPHONY.—The city of Piraeus recently celebrated the laying of the foundation-stone of the new telephone exchange building which is being erected under the terms of a concession awarded by the Greek Government to a German concern.

Hull.—TELEPHONE RATE RELIEF.—More than half of the surplus of £10,000 of the Corporation's telephone service is to be devoted to the relief of the local municipal rates.

Italy.—TELEPHONY.—Under private enterprise the number of subscribers has more than doubled in five years. When the State handed over the service to private enterprise in July, 1925, there were only 127,333 subscribers in the whole country. Statistics now show that the end of June, 1930, the total had reached 272,815, and the number is now estimated to be 300,000. Even so, the proportion of telephones to the population is only 0.8 per cent.

International Telephony.—ITALY-GERMANY.—As the result of the completion of a new underground cable between Milan and Rome, telephone communication entirely by underground cable is now possible between Rome and Berlin; the line comprises no fewer than 28 amplifying stations.

The Telephone Service.—LONDON EXCHANGES.—The number of exchanges in the London area is now 150, as compared with 137 at the end of 1929, which number includes 114 manual exchanges, 32 automatic exchanges, two toll exchanges, 1 trunk exchange, and 1 tandem or junction switching exchange. During 1930 the number of direct exchange lines increased by 24,461, or 6.4 per cent., to 409,200. The total number of telephones in the London area at the end of last year was 703,500, representing an increase on the year of 41,523, or 6.3 per cent.

Radio Notes.

Czecho-Slovakia.—LICENCES.—The number of broadcast receiving licences issued has reached the total of 300,000. The population of the country is some 12,500,000.

Denmark.—LICENCES.—The number of licences in use at the end of December, 1930, reached a total of 429,333, of which 9,400 were issued free to the blind, to cripples, and to chronic invalids. Denmark thus reached 12.1 licences per hundred inhabitants. The corresponding figures at the end of 1928 were 252,700, and at the end of 1929 368,927 licences, or, respectively, 7.19 and 8.79 per hundred inhabitants. In Denmark there are about 800,000 families, and 53.7 per cent. of them thus have receiving sets, probably the highest percentage in the world.

Interference.—CONFERENCE.—The subject of radio interference is to be discussed at a meeting of the International Broadcasting Union at Semmering, near Vienna, Austria, on February 1st. Most broadcasting organisations, including the B.B.C., will be represented at the conference.

Luxembourg.—INTERNATIONAL WIRELESS CONVENTION.—The Chamber ratified on January 21st Luxembourg's adherence to the Washington International Wireless Convention.—*Reuter.*

United States.—RECEIVERS.—"The most trying year in the history of the trade" is the description applied to 1930 by American radio manufacturers. The best estimates now available place sales of receivers during the year at 3,500,000. Many of these sets were produced in 1929, a year of over-production, and only now does it appear that the supply is becoming suitably related to the demand. With the Department of Commerce's pre-census estimate that 13,500,000 sets are in use in the United States to-day, and with the average life of a receiver reckoned at four years, it is estimated by the *Wirless World* that 3,000,000 sets will be needed in 1931 for replacements alone. In addition, the trade sees a market for at least 1,000,000 new sets.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—February 16th. Argentine National Sanitation Works Department. Water supply and drainage works, involving the supply of underground cable, generating sets, &c. (G.X. 10,002.)*

Australia.—MELBOURNE.—Posts and Telegraphs Department. February 10th. Telephonists' telephones for common battery working. (A.X. 10569.)*

February 17th. Electric lamps, lamp caps and sockets for voltages from 4 to 50. (A.X. 10643.)*

February 24th. Resistances in vitreous spools ranging from 100 to 4,000 ohms. (A.X. 10642.)*

March 17th. 80 miles of rubber-insulated, cotton-covered twisted conductors. (A.X. 10697.)*

April 7th. Testing instruments. (A.X. 10755.)*

March 31st. Single- and double-wound resistance spools. (A.X. 10754.)* Lead-covered telephone switchboard cable. (A.X. 10753.)*

Bridlington.—February 2nd. Town Council. Electrical installation in the new municipal offices. (January 16th.)

Cheadle and Gatley.—February 10th. Electricity Department. General supplies for twelve months. (January 16th.) Transformer and switch kiosk, a 6,600-V truck cubicle, and e.h.p. cable. (January 23rd.)

Chile.—SANTIAGO.—March 10th. Port Works Department. Ministry of Marine. Three electric slewing and travelling cranes, with portal, for the Port of Iquique. (A.X. 10740.)*

Denmark. — COPENHAGEN. — February 11th. Municipal Council. Switchgear for H. C. Oersted power station. (A.X. 10748.)*

Devon.—February 3rd. County Council. Automatic traffic-control signals. (January 23rd.)

Dundee.—February 11th. Electricity Department. 4-ton, overhead, travelling hand crane. (January 9th.) L.p. cable. (See this issue.)

Egypt. — CAIRO. — February 23rd. Ministry of Public Works. Generating, distributing, and pumping plant for Naga Hamadi barrage. (A.X. 10664.)*

SAMANOND.—February 28th. Ministry of the Interior. Supply and installation of an electrical distribution system for the town. (A.X. 10659.)*

Farnworth.—February 9th. Electricity Department. L.p. cable. (January 23rd.)

Fife.—February 16th. County Council. Heating and electrical work at Markinch Public School. Schedules (deposit £1 1s.) from Mr. G. Sandilands, architect, Education Offices, Kirkcaldy.

Gainsborough.—Electricity Department. Switchgear, suitable for operation on 6,600-volt supply and consisting of three isolating units and one circuit-breaker. (See this issue.)

Gloucester.—Corporation. Automatic traffic control signals. (See this issue.)

Halifax.—Town Council. February 9th. Electrician's work (wiring only) required in erection of 14 houses, Moor End Road. Specification (deposit £1 1s.) from Mr. A. C. Tipple, borough engineer, Crossley Street.

Hastings.—February 10th. Electricity Department. General supplies for twelve months. (January 16th.)

Hull.—February 16th. Electricity Department. Electrically-operated sluice valves (42 in. and 48 in.). Mr. J. N. Waite, city electrical engineer, electricity works, Sculcoates Lane (deposit £2). Static transformers. (See this issue.)

Ilford.—February 9th. Electricity Department. Rectifier and switchboards. (January 23rd.)

Leeds.—February 17th. Electricity Department. General stores for twelve months. (See this issue.)

London.—COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD.—February 9th. Main, auxiliary and multi-core cables and accessories for connections between the new and existing switch houses at Barking power station. (January 9th.)

CENTRAL ELECTRICITY BOARD.—February 2nd. 132,000-V transformers. (January 2nd.)

February 9th. Construction of site works, foundation works and buildings at Wigan and Southport in connection with the North-West England and North Wales Electricity Scheme. (January 9th.)

February 16th. 66,000-V and other cables in connection with the North-East England Electricity Scheme. (January 16th.)

February 23rd. Construction of site works, foundation works and buildings in connection with the North-East England Electricity Scheme. (See this issue.)

March 2nd. Central indication and telephone equipments in connection with the South-East England Electricity Scheme. (January 16th.)

March 9th. 33-kV overhead transmission lines in connection with the North-West England and North Wales Electricity Scheme. (See this issue.)

INDIA STORE DEPARTMENT.—February 10th. Cells. (See this issue.)

OFFICE OF WORKS.—February 2nd. Electrically-driven exhaust propeller fans and centrifugal blowing fan sets, &c.; also girders, steel joists, &c. Wiring and fittings for electric lighting at five casual wards. Wiring and fittings for electric lighting in tenement dwellings at Clapham. (January 16th.)

SOUTHWARK.—February 4th. Borough Council. Motor convertors, battery booster, and switchboards. (See this issue.)

L.C.C.—February 10th. Wiring and fittings for electric lighting for public staircases in tenement buildings in Stepney and Poplar. (January 23rd.)

February 17th. Wireless installation at Tooting Bec Hospital. (See this issue.)

February 16h. Wiring and fittings for electric lighting in tenement dwellings at the Stamford Hill housing estate, Hackney. (See this issue.)

HAMMERSMITH.—February 25th. Borough Council. General electrical stores for twelve months. (See this issue).

ISLINGTON.—February 6th. Cleansing Committee. Lead batteries for refuse-collecting vehicles. (See this issue.)

Manchester.—February 9th. Electricity Department. Electric cooking ranges. (See this issue.)

February 10th. Transport Committee. Permanent-way points, tongues and crossings, and general stores, including: Schedule A.—Commutator segments, armature coils, controller fingers, switches, bells, cells, &c., insulating material, overhead equipment material, tramcar trolley poles, electrodes for welding. Schedule B.—Cable (power and lighting), galvanised steel cable. Schedules from general manager, Corporation Transport Department, 55, Piccadilly.

New Zealand.—WELLINGTON.—Public Works Department. February 24th. One set of 110-kVA outdoor switchgear, steelwork and controlling equipment. (A.X. 10507.)*

March 17th. 11,000-V switchgear and metering equipment for controlling a 15,000-kVA sub-station. (A.X. 10719.)*

April 14th. Four single-phase 110-kV transformers. (A.X. 10721.)*

Post and Telegraph Department. March 3rd. Carbon diaphragms for telephone instruments. (A.X. 10720.)*

March 19th. 300 indicator alarm fuses. (A.X. 10747.)*

March 31st. 500 5-conductor cords. (A.X. 10746.)*

Northern Ireland.—BELFAST.—February 14th. Electricity Department. Steam boiler plant. (January 9th.)

February 21st. Electricity Department. General stores for twelve months. (See this issue.)

March 4th. Police Committee. Automatic traffic-control equipment. (See this issue.)

February 10th. Tramways Department. General stores for twelve months. (See this issue.)

Plymouth.—February 14th. Corporation. Meters, time switches, cables, transformers and e.h.p. switchgear. (January 23rd.)

Portsmouth. — February 2nd. Tramways Department. General stores for twelve months. (January 9th.)

Electricity Department. Water-tube boilers, with economisers, steel bunker, and steel building. (January 16th.)

South Africa.—PRETORIA.—March 13th. Town Council. Condensing plant and auxiliary apparatus for one or two large turbo-alternators. (G.X. 10,001.)*

JOHANNESBURG.—Railways and Harbours. February 16th. Material for colour light railway signalling. (A.X. 10662.)*

DURBAN.—February 20th. Corporation. Traffic control signals. (A.X. 10687.)*

CAPE TOWN.—February 18th. Electricity Department. L.p. ironclad switchgear for controlling lighting and power circuits on a 380/220-V 50-cycle, 3-phase, 4-wire a.c. system. (A.X. 10741.)*

March 12th. Airport illuminating equipment. (A.X. 10752.)*

Staffordshire.—February 3rd. Education Committee. Installation of electric lighting in several school buildings. (January 2nd.)

Tilbury.—February 2nd. Urban District Council. Installation of electric lighting and power and connecting-up of motors and control gear at refuse destructor. (January 16th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Croydon.—Electricity Committee. Recommended :—
6,000-V switchgear (£2,100).—A. Reyrolle & Co., Ltd.
2,000-V switchgear (£500).—Ferguson, Pailin, Ltd.
6,000-V transformers (£3,334) and 2,000-V transformers (£1,900).—British Electric Transformer Co., Ltd.
Two 3,000-amp. incoming group feeder equipments with reactors (£6,660); two 1,800-amp. interconnector feeder equipments (£2,044); two 1,800-amp. bus coupler equipments (£1,498); six 400-amp. split conductor outgoing feeder equipments (£6,168); two switch carriages and tank lowering and raising devices (£60); multicore cables (£1,600); contingencies (£1,000).—Metropolitan-Vickers Electrical Co., Ltd.

Government Contracts.—The following contracts were placed by the various Government Departments during December : —

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).
Alternators, motor and spares.—Haslam & Newton, Ltd.; Mackie & Co., Ltd.
Four-ton jib electric crane.—Cowans, Sheldon & Co., Ltd.;
Heating elements.—Credenda Conduits Co., Ltd.
Electric lamps.—General Electric Co., Ltd.
Switches, sockets, &c.—Engineering & Lighting Equipment Co., Ltd.; Gabriel & Co., Ltd.; General Electric Co., Ltd.; Hawkers, Ltd.; William McGeoch & Co., Ltd.
Aerial copper wire.—F. Smith & Co.

WAR OFFICE.
Conduits and fittings.—Stella Conduit Co., Ltd.

AIR MINISTRY.
Transmitters.—Johnson & Phillips, Ltd.
Valves.—General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.
Cables.—Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.
Electric light plant.—General Electric Co., Ltd.
Floodlight.—Chance Bros. & Co., Ltd.
Generating plant.—Ruston & Hornsby, Ltd.
Switchgear.—Metropolitan-Vickers Electrical Co., Ltd.
Telephones.—Ericsson Telephones, Ltd.

GENERAL POST OFFICE.
Protective apparatus.—Ericsson Telephones, Ltd.
Telephonic apparatus.—Automatic Telephone Manufacturing Co., Ltd.; General Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Plessey Co., Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones and Cables, Ltd.
Wireless apparatus.—General Electric Co., Ltd.
Cable.—British Insulated Cables, Ltd.; Connollys (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover & Co., Ltd.; Hackbridge Cable Co., Ltd.; Johnson & Phillips, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.
Loading coils.—Standard Telephones & Cables, Ltd.
Condensers.—Automatic Telephone Manufacturing Co., Ltd.; Condenser & Electric Co.
Electric light fittings.—General Electric Co., Ltd.; Revo Electric Co., Ltd.; J. H. Tucker & Co., Ltd.
Galvanometers.—India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.
Tungar rectifiers.—Edison Swan Electric Co., Ltd.
Bronze and cadmium copper wire.—F. Smith & Co.; Whitecross Co., Ltd.
Copper wire.—Enfield Cable Works, Ltd.; Nevill Druce and Co., Ltd.; Pirelli-General Cable Works, Ltd.; Shropshire Iron Co., Ltd.; Whitecross & Co., Ltd.
Cable (manufacture, supply, drawing-in and jointing).—G.P.O. (South)—Wood Street, E.C.: Standard Telephones & Cables, Ltd.
Telephone exchange equipment.—London Telephone Service (Cornwall House), Clerkenwell (London), National (London), Darlington and Bayswater (London Area).—Standard Telephones & Cables, Ltd. Sub-contractors for Bayswater: Electric Construction Co., Ltd., for motor generator sets and ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Headingley and Armley (Leeds Area), Chorlton-cum-Hardy, Didsbury and Rusholme, Manchester Central, Manchester City, Manchester Auto-Manual and Manual Operating School and Pendleton (Manchester Area).—Automatic Telephone Manufacturing Co., Ltd. Sub-contractors for Pendleton: Electric Construction Co., Ltd., for motor generators and ringing machines; Alton Battery Co., Ltd., for batteries. Edinburgh Central and Abbeyhill (Edinburgh Area): Siemens Bros. & Co., Ltd. Sub-contractors for Abbeyhill: Small Electric Motors, Ltd., for dynamotor. Selly Oak (Birmingham Area): Siemens Bros. & Co., Ltd. Sub-contractors: English Electric Co., Ltd., for charging machines; Crompton Parkinson, Ltd., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Colindale (London Area): Ericsson Telephones, Ltd. Sub-contractors: Electric Construction Co., Ltd., for motor generator sets and ringing machines; Pritchett & Gold and E.P.S. Co., Ltd., for batteries.
Telephonic repeater equipment—Fenny Stratford, Derby, Manchester, Liverpool, London (G.P.O. South), Leeds, Aberdeen, Jedburgh, Newcastle, Edinburgh, Dundee and Glasgow: Standard Telephones & Cables, Ltd. Canterbury and Leicester: General Electric Co., Ltd.

Grimsby.—Electricity Committee. Recommended :—
Switchgear in connection with supply to the Grimsby Ice Co. (£2,711).—A. Reyrolle & Co., Ltd.

Glasgow.—Health Committee. Recommended :—
Electric lighting at superintendent's house, Ruchill Hospital (£92).—Darroch & Espie.
Electricity Committee. Accepted :—
Plant and appliances in connection with standardisation of frequency.—Eleven new motors (£667).—Metropolitan-Vickers Electrical Co., Ltd. Two new motors (£218).—Harland Engineering Co., Ltd.
Meters.—Metropolitan-Vickers Electrical Co., Ltd.; Edison Swan Electric Co., Ltd.: Ferranti, Ltd.
Transformer ratio meters.—Metropolitan-Vickers Electrical Co., Ltd., Edison Swan Electric Co., Ltd.
Transport Committee. Recommended :—
Watthour meters and ammeters.—General Electric Co., Ltd.
Education Committee. Accepted :—
Electric lighting at Bankhead School (£320).—Darroch and Espie.

London.—L.C.C.—Highways Committee. Accepted :—
Two 20,000-kW turbo-alternators, condensing plant, &c. :—

	£
British Brown-Boveri, Ltd. (turbo-alternators manufactured abroad)	142,378
General Electric Co., Ltd.	149,913
General Electric Co., Ltd. (Alternative) ...	153,069
Brush Electrical Engineering Co., Ltd. ...	152,570
English Electric Co., Ltd.	153,107
British Thomson-Houston Co., Ltd.	155,137
Richardsons, Westgarth & Co., Ltd.	155,800
Brush Electrical Engineering Co., Ltd. (Alternative)	156,930
Richardsons, Westgarth & Co., Ltd. (Alternative)	157,400
Metropolitan-Vickers Electrical Co., Ltd. ...	158,485
British Thomson-Houston Co., Ltd. (Accepted, alternative)	**162.973**
General Electric Co., Ltd. (Alternative) ...	163,796
Metropolitan-Vickers Electrical Co., Ltd. (Alternative)	164,217
Richardsons, Westgarth & Co., Ltd. (Alternative	167,300
Metropolitan-Vickers Electrical Co., Ltd. (Alternative)	169.953
C. A. Parsons & Co., Ltd.	173,374
English Electric Co., Ltd. (Alternative) ...	174,784

The British Thomson-Houston Co., Ltd., proposes to sub-let the condensing plant to Hick-Hargreaves & Co., Ltd.
Conductor rails (£7,880).—Frodingham Iron & Steel Co., Ltd.
Track rails and fish plates (£50,927).—Dorman, Long and Co., Ltd.
Five electric tramcar traversers (£2,525).—Holt & Willetts.
Education Committee. Accepted :—
Electric lighting installation at schools.—Buchanan and Curwen (Charlton Park); Eastern Armature Winding Co. (Wormholt Park Central); T. Clarke & Co., Ltd. (Hollydale Road); Electrical Installations, Ltd. (Shoreditch Central mixed school).

HAMMERSMITH.—Electricity Committee. Recommended:—
Wiring of showroom and offices in Uxbridge Road (£630).—Twentyman & Willmott, Ltd.
Accepted:—
Supply and installation of inter-office telephone system at the showroom (£120).—Reliance Telephone Co., Ltd.

Southend-on-Sea.—Town Council. Accepted:—
250-kW convertor for Thorpe Bay sub-station, and transfer of certain machinery (£4,102).—General Electric Co., Ltd.
Apparatus for the change-over for the western section of Eastern Esplanade (£122).—W. Jay.
Six electric lamps for St. John's Steps (£123).—F. P. Richard & Co.

Stoke-on-Trent.—Electricity Committee. Accepted:—
New armature for rotary convertors at Longton (£415).—Metropolitan-Vickers Electrical Co., Ltd.
Battery-charging plant at Hanley (£31).—Edison Swan Electric Co., Ltd.

Forthcoming Events.

Electroplaters' and Depositors' Technical Society.—Friday, January 30th. Lyons' Corner House, Islington, N. First annual dinner.

Society of Engineers.—Monday, February 2nd. Geological Society, Burlington House, W. 6 p.m. Presidential address. Mr. H. W. Towse.

Paisley Association of Electrical Engineers.—Tuesday, February 3rd. Y.M.C.A. Board Room, Paisley. 7.30 p.m. "Sidelights on Electrical Supply." Mr. W. Blair Smith.

Electrical Society of Glasgow.—Tuesday, February 3rd. Reid's Smoke Room, Glasgow. 7.30 p.m. "The Production and Reproduction of Talking Motion Pictures." Mr H. S. Hind.

Royal Society of Arts.—Wednesday, February 4th. Society, Adelphi, London. 8 p.m. "The Effect of Standardisation on Engineering Progress. Mr. C. le Maistre.

Institution of Electrical Engineers.—Thursday, February 5th. Institution, London. 6 p.m. "Two Transmission Line Problems: Suspension Insulators for Industrial Areas in Great Britain; Conductor Vibration." Mr. P. J. Ryle.

(West Wales (Swansea) Sub-Centre).—Friday, January 30th. Corporation Electricity Showrooms, Swansea. 6 p.m. "The Electrical High-pressure Testing of Cables and the Localisation of Faults." Mr. J. Urmston.

(North-East Students' Section).—Saturday, January 31st. Joint visit with the graduates of the North-East Coast Institution of Engineers and Shipbuilders to Vickers-Armstrongs' Elswick Works, Newcastle-upon-Tyne.

(Western Centre).—Monday, February 2nd. Cardiff. "The Cooling of Electrical Machines." Mr. D. B. Hoseason.

(London Students' Section).—Tuesday, February 3rd. Institution, London. 6.15 p.m. "The Relations between Engineering and Economics." Mr. N. F. T. Saunders.

(Dundee Sub-Centre). — Tuesday, February 3rd. Lamb's Restaurant, Dundee. 7.30 p.m. Informal discussion.

(North-Western Students' Section).—Tuesday, February 3rd. Engineers' Club, Manchester. 7.15 p.m. "Manufacturing Problems of the Electrical Industry." Mr. J. Randle.

(Meter and Instrument Section).—Friday, February 6th. Institution, London. 7 p.m. Short papers.

(North-Eastern Centre). — Friday, February 6th. Literary and Philosophical Society, Newcastle-upon-Tyne. 7 p.m. Faraday lecture. "The Birth of Electrical Engineering." Prof. W. Cramp.

(Wireless Section).—Wednesday, February 4th. Institution, London. 6 p.m. "Some Measurements of a Loud-speaker in Vacuo." Mr. P. K. Turner.

(South Midland Students' Section).—Tuesday, February 3rd. University, Birmingham. 7 p.m. "Porcelain Insulators." Mr. G. H. Halton. Saturday, February 7th. Combined visits to Stourport power station and the Steatite and Porcelain Product Co.'s works, Stourport.

Batti-Wallahs' Society.—Thursday, February 5th. Hotel Metropole, London. 12.30 p.m. for 1 p.m. Luncheon. "Labour Conditions in the Electricity Supply Industry." Ald. W. Walker.

Physical Society.—Friday, February 6th. Imperial College of Science, South Kensington, S.W. 5 p.m. Short papers.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, February 7th. Royal Hotel, Cardiff. Annual dinner.

Electrical Power Engineers' Association (Northern Division, Manchester Section).—Saturday, February 7th. Cheetham Town Hall, Manchester. 6.30 p.m. Social evening and dance.

Notes.

Fulham's Power Station.

As the result of the inquiry by the Electricity Commissioners into the application of the Fulham Borough Council for permission to extend its electricity generating station (see ELEC. REV., December 26th, 1930, and January 2nd, 1931) the Commissioners have approved of the extension of the plant. The first section will be of 132,000-kW capacity and the ultimate capacity is to be 318,000 kW.

Faraday House Old Students' Association.

The Faraday House Old Students' Association and Faraday House Rugby Club have arranged to hold a supper dance on February 13th at the Hotel Russell, Russell Square, W.C., from 8 p.m. to 2 a.m. The price of a double ticket, including supper, is 15s., and of a single ticket 8s. 6d. Application for tickets should be made to the Hon. Secretary of the Association, Faraday House, Southampton Row, W.C.1.

Automatic Traffic Signals.

A list of the towns in Great Britain where automatic traffic signals are in operation has been compiled by the R.A.C. At present there are 63 towns where such signals are working, and in the majority of cases the three-light system (red meaning stop, green meaning go, and orange being a warning that the light is about to change) is employed. Failure to obey these signals is now an offence under the Road Traffic Act.

A French Contemporary.

We desire heartily to congratulate our esteemed French contemporary *L'Industrie Electrique* as it celebrates the fortieth year of its existence. Our contemporary was founded by the late Dr. E. Hospitalier, who was a frequent contributor to, and a friend of, the ELECTRICAL REVIEW. Hospitalier will be remembered as a man of strong independence in technical criticism, and in his reference to the 40th year of the paper the editor takes pride in the fact that during the whole period the journal has faithfully followed his traditions.

Large Boilers at Hell Gate Power Station.

Two new boiler units, which, with the building in which they are housed, coal-pulverising mills, and other auxiliaries, were built at a cost of approximately £1,000,000, are reported by the *Electrical World* to have been put into service in New York City by the United Electric Light & Power Company at its Hell Gate generating station, which has a rating of 694,000 kVA.

These boilers, manufactured by Messrs. Babcock & Wilcox, Ltd., supply steam to drive one of the 160,000-kW turbo-generators. Each boiler has a nominal rating of 800,000 lb. of steam per hour at 275 lb. per sq. in. and 725 deg. F. They have many new features of design. All fans, mills, feeders, and dampers are controlled from a central operating board, thus centralising the control to an extent said never before to have been attempted. At maximum capacity there is burned in the furnace for each boiler about 100,000 lb. of coal per hour, and the output exceeds 1,000,000 lb. of steam per hour. The furnace ash is discharged periodically in molten form.

High-voltage Cable Technics.

Dr. H. Reinheimer has sent us a copy in German of the paper he recently read before the Upper Silesian Electro-Technical Society, at Hindenburg, on the subject of "Problems of Present-day High-voltage Cable Technics." The author, who is apparently associated with the research laboratory of the North German Cable Works Co., of Neukölln, Berlin, deals thoroughly with the constructional details and electrical and physical properties of h.p. cables up to those capable of transmitting power up to 100,000 V. Special attention is devoted to the triple-conductor cables, tests of which have shown that those in which the separate conductors are individually lead-sheathed suffer less deformation under bending strains than those in which only one sheathing common to all three conductors is employed.

Institute of Transport.

EXAMINATIONS.—Revised regulations and syllabuses will come into force on October 1st, 1931. Important alterations have been made, particularly in the subjects of the examinations, the conditions under which they may be sat for, and those governing the grant of exemptions.

Fatality.

Ernest Benson, aged 15, employed by Messrs. Abraham Ashton & Sons, Ltd., Sheffield, was found lying dead on the top of a gas furnace, with an electric light wire in one hand, and near by there was a broken lamp. At the inquest held recently Dr. Little said death was due to electric shock. Mr. A. J. McColgan, H.M. electrical inspector of factories, expressed the opinion that the boy was killed by a shock at 200 V a.c. from the Corporation's main. He thought he received the shock from a defectively insulated wire at a point near the lamp socket. The jury returned a verdict of "Accidental death."

Tramways and Light Railways Returns.

The Ministry of Transport returns of Tramways and Light Railways (Street and Road) and Trackless Trolley Undertakings, for the year 1929-30 in the case of local authorities and 1929 for companies (H.M. Stationery Office, price 2s. 6d. net), cover 217 tramway concerns, as compared with 221 for the previous year, including 160 (161) municipally owned. Seventeen of the undertakings had ceased to operate at the end of the year. The total capital expenditure on tramways by local authorities was £82,115,699, as compared with £81,573,886 for the previous year, and by companies £17,460,297, as against £18,924,849. The gross receipts of the municipalities were £23,217,975, as compered with £23,292,621 for 1928-29, and the working expenses were £18,177,680, against £18,332,185, leaving net receipts of £5,040,295 (£4,960,436). For the companies the gross receipts were £3,551,110 (£3,774,593), working expenses £2,978,788 (£3,147,550), and the net receipts £572,322 (£627,043). The combined ratio of working expenses to gross receipts is 79.03, compared with 79.36 for the previous year. The route miles authorised at the end of the period under review were 2,574, of which 2,323 miles were open for traffic, 1,765 miles being worked by local authorities and 558 by companies. The number of passenger journeys effected during the year was 4,613,526,659, representing a decrease of 0.21 per cent. from the figure for the preceding year. The car-miles run amounted to 349,277,530, a decrease of 0.51 per cent. The electrical energy used totalled 842,732,629 kWh, or 2.14 kWh per car mile, as compared with 817,492,187 kWh, or 2.07 kWh per car mile, for the previous year.

The returns also include twenty-two railless-trolley undertakings, twenty municipal and two company concerns. Twenty-three other local authorities and three companies had the necessary powers, but their undertakings were not open for traffic during the period under review. The total capital expenditure for the year was £1,967,298 (£1,379,385), the gross receipts were £788,062 (£616,950), the working expenses £581,268 (£461,195), and the net receipts £206,794 (£155,755). The ratio of working expenses to gross receipts is 73.76 per cent., as against 74.75 per cent. The route miles open for traffic were 168.76, as against 132.03, and the car-miles run were 13,671,161 (10,456,379). The electricity consumed amounted to 21,854,443 kWh, or 1.6 kWh per car mile, as compared with 16,001,903 kWh, or 1.53 kWh per car mile.

Lighting on s.s. "Empress of Japan."

An excellent example of co-operation between the electrical engineer and the architect is represented in the accompanying

Gallery Promenade Deck Lighting.

illustration, a view of the first-class long gallery promenade on s.s. *Empress of Japan*, the electrical equipment of which ship was described by Mr. W. E. Swale in our issues of August 15th and 22nd last. The single-lamp light fittings are fixed at the centres of specially designed wood features, and the result is very pleasing, both in illumination and effect. The lighting fittings were supplied by the General Electric Co., Ltd., which, in conjunction with the architects, Messrs. Staynes & Jones, designed many of the fittings employed throughout the ship.

Index to British Standard Specifications.

The 1931 edition of the Index List of British Standard Specifications has just been issued. It is a complete subject index which, in view of the large number (410) of British Standard Specifications now available, some of which include provisions for several articles or materials, will be of much assistance to those purchasing engineering and allied material, apparatus and machinery. A numerical list of the specifications is also included. Copies of the List are available from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1, price 1s. 2d., post free.

Appointments Vacant.

Mains engineer for Worksop Urban District Council Electricity Department.

Mains assistant for Winchester Electricity Department.

Assistant examiners in Patent Office for the Civil Service Commission.

Chief clerk for Willesden Electricity Department.

Lady demonstrator at electricity showrooms for Epsom Electricity Department.

(See our advertisement pages to-day.)

Big Mercury-vapour Turbine.

The General Electric Company of America intends to erect a four million dollar power plant for its works at Schenectady, which will include the largest mercury-vapour turbine ever built. Mr. W. L. R. Emmet's new turbine will have a capacity of 26,700 h.p., and is expected to result in a substantial saving in fuel, compared with the ordinary steam-generating equipment. The mercury required for the boiler will weigh 250,000 lb.—*Reuter's Trade Service* (New York).

Highfield Shield Competition.

The winner of the W. E. Highfield shield in the eighth annual competition held under the auspices of the Association of Supervising Electrical Engineers is Mr. D. J. Williams Pontilanfraith, for the second year in succession, who also wins the first prize of five guineas presented by Metropolitan-Vickers Electrical Co., Ltd., for his paper on "The Supervising Electrical Engineer—Education, Training and Responsibility." The other prize winners in the members' class are: 2nd prize, 4 guineas (Siemens Bros. & Co., Ltd.), Mr. G. H. Conway, Acharacle, "Rural Electricity Distribution"; 3rd prize, 3 guineas (the Sun Electrical Co., Ltd.), Mr. E. J. Wells, Leicester, "Executive Work in connection with Maintenance." The prize winners in the class of associates are:—1st prize, 5 guineas (W. T. Henley's Telegraph Works Co., Ltd.), Mr. F. Anderson, Windygates, Fife, "The Effect of Frequency Change upon Transformer Operation"; 2nd prize, 3 guineas (Revo Electric Co., Ltd.), Mr. J. W. Hutchings, London, "Electrical Wiring Supplies, Fittings and Accessories." The presentation of the shield and prizes will take place at the annual dinner of the Association on February 21st at the Hotel Great Central, London.

Scottish Water-power.

Prof. F. G. Baily, of the Heriot-Watt College, Edinburgh, lectured recently to the Royal Geographical Society, Edinburgh, on the "Water-power Resources of Scotland." He said there was a theoretical possibility of three million kilowatts being obtainable in Scotland, based on a rainfall of 50 inches per annum and an average height of 700 ft. One-twelfth part of that was actually obtained, or in process of being obtained. If no other source of power were available, it would be possible to make use of a large proportion of the three millions, though at a considerable cost. At present power was easily obtained from coal, and only that part of the water power was useful which could be supplied to the consumer at no greater cost than a supply from a steam-driven station. While water cost nothing, the engineering work of collecting it and conveying it to the turbine station was generally great, and might easily absorb the cost of the coal which the water replaced. A report by a Commission in 1919 indicated that in many places water-power could be advantageously obtained, but since then the cost of steam stations and the consumption of coal had both been reduced by one half. Many schemes which at that time were promising were now not economically sound. Water-power stations were not only remote from the present populous areas, which were round the coalfields, but the country in their neighbourhood was unsuitable for a large population, so that the power had to be transmitted to a long distance at an increased cost. The more habitable parts of Scotland were either near to the coalfields or near to the coast, so that sea-borne coal could be cheaply obtained. Even for manufacturing purposes a large station on the Fife coast, assured of an ample coal supply and condensing water, and with transport by sea and rail, could compete with almost any water-power station in the world. Several existing, prospective, and suggested schemes were described by the lecturer (Clyde Valley, Kinlochleven, Lochaber, the Grampian, Galloway, and West Highland) and their prospects discussed. The Kinlochleven station could defy competition, but the improvements in steam stations in the last few years and anticipated future advances in economy made the position of the others less favourable than appeared at the times when they were

initiated, while further developments had no chance of success. The countries in which water-power had been developed either had no coal or contained large areas remote from their coal-fields, and the power for the most part was not cheaper than from large stations in Britain. So long as the coal held out at a moderate price water-power was not required. At some future date, if inventors had not by then provided a new source of power, it would be possible to link up all the power from rivers and streams and from the tides, which would provide a liberal supply for a population as large as the present one. To-day, the Professor concluded, such a scheme would be a waste of money.

Institute of Metals.

At the annual general meeting of the Institute, which is to be held on March 11th and 12th in London, fourteen papers will be presented for discussion. On the evening of March 11th the annual dinner and dance will be held at the Trocadero Restaurant.

The Institute has just issued the first (January) number of its new monthly *Journal*, containing original articles, Institute news, and several hundreds of abstracts of the world's metallurgical literature, 96 pages in all. Hitherto the *Journal* has appeared in the form of half-yearly volumes divided into two sections: "Proceedings" and abstracts. Henceforward the volumes issued each June and December will contain only "Proceedings," and the abstracts will appear monthly, to be re-issued in volume form at the end of each year. The effect of this arrangement will be to speed up the receipt of the abstracts, which can be used for card indexing purposes.

Domestic Supply in the U.S.A.

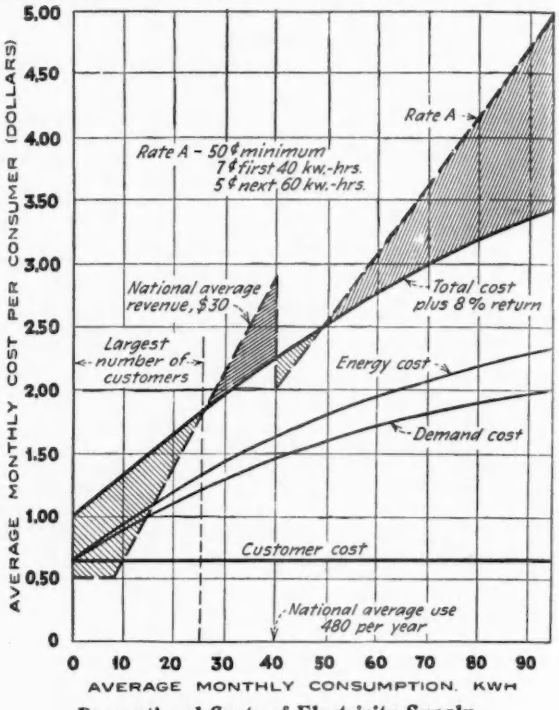
Domestic business has proved very stable during the period of industrial depression. Data from 41 large undertakings in the U.S.A., reported in the *Electrical World*, show that energy sales to domestic consumers have increased 22 per cent. in four years. The national average for these undertakings has increased from 447 kWh in 1925 to 547 kWh per consumer in 1929. They sold an aggregate of 2,702,376,747 kWh to residential consumers in 1929.

Full-use electric service in homes corresponds to about 7,000 kWh per year, and the 547 figure shows how far from saturation is this class of business. The refrigerator has aided greatly in increasing the business, and the water heater and cooker are being sold energetically. During the year many inducement rates were adopted by undertakings and about fifteen now have off-peak water-heating rates that have proved to be effective in encouraging this business.

A study of the domestic business in the several geographical sections shows that the Pacific States lead with 890 kWh per consumer; the next highest is the East-North Central region, with 595 kWh, and the lagging region is the South Central, with only 418. It is striking to find the large cities in the industrial regions of the country ranking very high in consumption per consumer despite the dilution effect of many small apartments.

Undoubtedly the electric refrigerator has been chiefly instrumental in increasing domestic use generally in the past four years, and the coming campaign should augment this effect; but there remains a very large business to be had, and the cooker and water heater are but stepping-stones to house heating and air conditioning, with a possible economic domestic use of 40,000 kWh per home for a large percentage of the consumers.

It is estimated that from 50 per cent. to 75 per cent. of the residential consumers are served at a loss. For domestic rates to be equitable for large users as well as small users there should be a charge based on investments in service facilities, as well as a charge based on energy use. The cost of energy is a relatively small part of the total cost of serving for the majority of domestic consumers. Either their consumption must be increased, large-use consumers pay part of their cost, or some form of capital charge must be added to the energy charge.



Proportional Costs of Electricity Supply.

The above curves show the necessity of a proper allowance for capital charges in the tariff. (It should be compared with the curve which accompanied the article entitled "The Two-part Tariff" by G. L. Porter, which appeared in the ELECTRICAL REVIEW of November 14th, 1930.)

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. A. C. Cramb is to be given a complimentary dinner on his leaving Croydon to take up the post of Director and Secretary of the British Electrical Development Association on February 19th, at the Holborn Restaurant, by the ex-members of the Croydon Electricity Department staff. Over 30 have intimated their intention to be present. There are, however, a large number of ex-members whose addresses are not known. If any of these gentlemen desire to be associated with this function they are asked to communicate with the honorary secretary, Mr. H. E. Mortimer, 219, Tottenham Court Road, W.1.

Mr. J. A. Hartigan has left the service of the London Fan and Motor Co., Ltd., and **Mr. R. J. Millard,** late branch manager in Yorkshire for Messrs. Veritys, Ltd., has been appointed to succeed him.

Mr. S. R. Mullard, chairman of the Mullard Wireless Service Co., Ltd., has joined the board of Radiovisor Parent, Ltd.

Mr. C. E. Abell, vice-chairman of the S.W.S. Area (E.D.A.) Circle, accompanied by **Mr. M. M. Harvey,** the chief officer of the Shropshire, Worcestershire and Staffordshire Electric Power Co. dealing with the application of electricity in agricultural development, visited France last week to inspect some recent applications of electricity to agricultural work in that country.

Mr. J. H. Shepherd, who has been appointed electrical engineer of Rawtenstall, joined the staff of the Electricity Department 17 years ago, after experience with Messrs. Whipp and Bourne, of Rochdale. Since 1922 he has held the position of mains superintendent.

Mr. H. W. Adams, of the General Electric Co., Ltd., has consented to act as a member of the delegation which the London Chamber of Commerce is sending to Buenos Aires in connection with the British Empire Trade Exhibition.

Mr. Archibald McKinstry, who has recently been appointed to the board of Babcock & Wilcox, Ltd., was described in our last issue as a director of the Metropolitan-Vickers Electrical Co., Ltd. Mr. McKinstry informs us, however, that he severed his connection with the Metropolitan-Vickers Co., Associated Electrical Industries, Ltd., and their connected companies on December 31st.

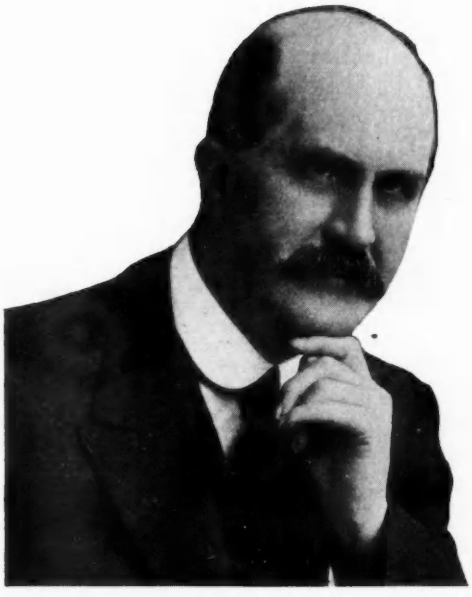
Mr. G. Leslie Wates has been elected chairman of Johnson and Phillips, Ltd., in succession to the late Mr. John McGregor. Mr. Wates has been a director of the company since 1927.

Sir Ernest Rutherford, who received a peerage in the New Year's Honours List, has announced that he is taking the title of **Lord Rutherford of Nelson,** of Cambridge.

Mr. James Drumm, the inventor of the Drumm accumulator, had the degree of Doctor of Science conferred on him by the National University of Ireland last week.

Mr. L. V. Turner, mains superintendent, has been appointed deputy chief electrical engineer by the Taunton Town Council, at a salary of £441 per annum.

Sir William H. Bragg, K.B.E., F.R.S., &c., was elected an honorary member of the Institution of Electrical Engineers at a meeting of the Council of the Institution last week. There are now fourteen hon. members, including the Prince of Wales. Sir William Bragg who is 68 years of age, has had a most distinguished scientific career, and in the sphere of radio-activity he is one of the world's foremost authorities. He was president of the British Association in 1928-29 and he is at present director of the Royal Institution of Great Britain and director of the Davy-Faraday Research Laboratory. We reproduce a portrait of Sir William herewith.



Elliott & Fry] *[London.*

Sir William Bragg, K.B.E., F.R.S.

Who has been elected an hon. member of the I.E.E

Mr. Archibald J. Boyd has been appointed to the board of the Metropolitan-Vickers Electrical Co., Ltd.

Mr. Sidney T. Batley has resigned the position of managing director of Messrs. Greenwood & Batley, Ltd., but remains on the board. He is succeeded as managing director by **Mr. J. C. M. Maclagan.**

Obituary.

Col. H. Laws Webb.—We regret to record the death of Col. Laws Webb which occurred on the 19th inst. at 128, Piccadilly, London, at the age of 66 years. Col. Webb may be said to have been born into the electrical world, for his father was engaged with the Silvertown Company as a submarine cable engineer. F. H. Webb, for many years secretary of the Institution, was his uncle. Herbert Laws Webb was first engaged in submarine cable work. In 1889 he entered the service of the New York Telephone Co., and eventually became assistant manager. Later he returned to London and practised as a consulting engineer, specialising in telephony. He gave evidence at the Glasgow telephone inquiry in 1897 and at most of the Local Government Board inquiries which were required in connection with municipal telephone systems inaugurated as a result of the findings of the Select Committee of 1898. He was a strong advocate of private enterprise in telephony. "As an Alternative to State Monopoly" he proposed, in an address to the London Chamber of Commerce, in 1911, the formation of "A 'Telephone Authority' for Great Britain . . . . on the lines of the Port of London Authority," a proposal which has been revived recently. He contributed numerous articles to the Press and published books both on the technical and service sides of telephony. He negotiated with the Turkish Government a concession for telephones and had been a director of the Constantinople Telephone Co. since its formation. During the war he joined the Royal Air Force in connection with communications and attained the rank of lieut.-col. The funeral took place at Golders Green on Friday last.

Sir William Bull.—We regret to record the sudden death, on January 23rd, of the Rt. Hon. Sir William Bull, Bt., P.C. Sir William was probably best known to the electrical industry by his connection with the Radio Manufacturers' Association, of which he had been president from its inception. He was also a director of Siemens Bros. & Co., Ltd. He was a solicitor by profession. For 28 years he represented Hammersmith in Parliament and he was chairman of the House of Commons Channel Tunnel Committee. He retired from active politics under medical advice about two years ago. Sir William was 67 years of age.

Mr. T. M. Hall.—The death occurred recently of Mr Thomas M. Hall who was chief designer to Messrs. Smith, Major & Stevens, Ltd., lift manufacturers.

Mr. T. Valentine.—The death is announced of Mr. Thomas Valentine, who was secretary to Messrs. S. H. Heywood and Co., Ltd., electrical engineers, of Manchester, and crane makers, of Reddish.

Mr. J. Ashworth.—Mr. H. C. Day, manager of the Heywood Corporation Electricity and Tramway Departments, informs us that Mr. J. Ashworth, J.P., who was for more than 20 years vice-chairman and chairman of the Heywood Electricity Committee, and represented his undertaking at many I.M.E.A. Conventions, died on January 12th in his 80th year.

Financial Section.

New Companies, Returns of Share Capital, Debenture Charges, Reports of Electrical Companies, Dividend Changes, Transactions in Stocks and Shares.

New Companies Registered.

Radcells, Ltd.—Private company. Registered January 20th. Capital, £500 in £1 shares. Objects: To carry on the business of radio and wireless consultants, experts and service agents. &c. The permanent directors are: C. W. Norman (chairman and managing director), 99, Denmark Road, Beccles, Suffolk; A. L. Norman, 99, Denmark Row, Beccles, Suffolk; T. E. Norman, "Brooklyn," Larkman's Lane, Norwich. Secretary: A. L. Norman.

Wakefield Bros., Ltd.—Private company. Registered January 21st. Capital, £500 in £1 shares. Objects: To acquire the business of electrical and radio engineers and contractors carried on by M. W. Wakefield and P. A. Wakefield as "Wakefield Bros.," at 6, Hallswelle Parade, Temple Fortune, N.W.11 The permanent directors are: S. Bridgwater (chairman), Bridgwater Villa, Raleigh Road, Hornsey, N.8; M. W. Wakefield, 19, Hillside Gardens, Edgware, Middlesex; P. A. Wakefield (managing director), 21, Hillside Gardens, Edgware.

Radio Doctors, Ltd.—Private company. Registered January 22nd. Capital, £1,000 in £1 shares (500 7½ per cent. cumulative preference and 500 ordinary). Objects: To carry on the business of radio engineers, electricians, mechanical engineers, technical advisers, manufacturers and workers of electricity, &c. The subscribers are: Capt. T. Parnell, "Weir End," Sunbury-on-Thames, engineer; A. W. Bayley, 11, Gipsy Hill, Norwood, S.E.19, managing clerk. Capt. T. Parnell is permanent managing director. Registered office: 36, Victoria Street, Westminster, S.W.1.

Kellens, Ltd.—Private company. Registered January 16th. Capital, £100 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in motor-car and other batteries, magnetos, dynamos and all electrical and other equipment relating thereto. The subscribers (each with one share) are: W. E. Howard, 197, North Hill, Highgate, N.6, accountant; G. M. F. Trollope, "Greystones," Creste Road, Hawkinge, Kent, printer. Secretary: F. C. Allen, 53, Pyrland Road, N.5.

D. & L. Shapiro, Ltd.—Private company. Registered in Edinburgh January 8th. Capital, £100 in £1 shares. Objects: To carry on the business of importers and wholesale distributors of electrical and gas fittings, &c. The directors are: L. Shapiro, electrical factor, and Mrs. S. Shapiro, 115, Cartvale Road, Glasgow. Secretary: J. A. Dunlop. Registered office: 74, Bath Street, Glasgow.

John Roberts (Stockport), Ltd.—Private company. Registered January 20th. Capital, £1,000 in £1 shares. Objects: To acquire the business hitherto carried on by John Roberts at 14, Wellington Road South, Stockport, and to carry on the business of car lighting specialists, motor and radio engineers, manufacturers of and dealers in motor cars and accessories, lamps, wireless goods, batteries, electrical accessories, &c. The permanent directors are: J. Roberts, 5, Sandileigh Avenue, Withington, near Manchester; B. C. Hughes, 52, Ashburn Road, Heaton Norris, Stockport. Registered office: 14, Wellington Road South, Stockport.

Brown, Brew & Co., Ltd.—Private company. Registered January 23rd. Capital, £500 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in wireless apparatus, gramophones, &c. The directors are: H. Brown, 13, Ranelagh Road, Wellingborough, electrical engineer (permanent managing director); F. C. Brew, Blacksmiths Lane, Pytchley, near Kettering, electrical engineer. Solicitor: R. Ward, Wellingborough.

McAllister Chemical Co., Ltd.—Private company. Registered January 23rd. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers of accumulator separators, accumulators, batteries, dynamos, magnetos, telephones or telegraphs. The directors are: F. G. Creed (chairman), 19, Outram Road, Croydon (director W. H. Storey and Co., Ltd., and other companies); W. McAllister, 42, St. Albans Avenue, Chiswick, W.4. Secretary: W. McAllister.

Electrical & General Development Co., Ltd.—Private company. Registered January 23rd. Capital, £20,000 in £10 shares. Objects: To generate, store, transmit, purchase and supply electrical or other energy for motive power, light, heat or any other purpose, &c. The provisional directors are: T. H. Minshall, 34, Victoria Street, S.W.1, engineer; J. Leggat, 32, Victoria Street, S.W.1, engineer.

Official Returns of Electrical Companies.

Liverpool Electrical Installation Co., Ltd.—Capital, £2,500 in £1 shares. Return dated September 8th, 1930. 1,827 shares taken up. £1,827 paid. Mortgages and charges, nil.

Charles Payne, Ltd.—Capital, £1,500 in £1 shares. Return dated May 31st (filed December 10th), 1930. All shares taken up. £1,500 considered as paid. Mortgages and charges, nil.

Fairbourne Development Co., Ltd.—Capital, £1,000 in £1 shares. Return dated August 11th, 1930. 660 shares taken up. £660 paid. Mortgages and charges, nil.

Electric Development & Securities Trust, Ltd.—Capital, £10,000 in £1 shares. Return dated November 24th, 1930. All shares taken up. £10,000 paid. Mortgages and charges, nil.

Movie-Signs, Ltd.—Capital, £2,500 in £1 shares. Return dated October 8th, 1930. 2,065 shares taken up. £2,065 paid. Mortgages and charges, nil.

Electronos, Ltd.—Capital, £3,500 in 2,000 preference and 1,500 ordinary shares of £1 each. Return dated December 1st, 1930. 950 preference and 1,345 ordinary shares taken up. £1,795 paid on 950 preference and 845 ordinary shares. £500 considered as paid on 500 ordinary shares. Mortgages and charges, nil.

Octron, Ltd.—Capital, £3,000 in 2,850 preference shares of £1 and 3,000 ordinary shares of 1s. each. Return dated November 26th, 1930. All shares taken up. £3,000 paid. Mortgages and charges, £2,500.

Radio Relays, Ltd.—Capital, £7,500 in £1 shares. Return dated January 5th, 1931. 4,425 shares taken up. £4,425 paid. Mortgages and charges, nil.

Carbo Electric Corporation, Ltd.—Capital, £100 in £1 shares. Return dated December 31st, 1930. Two shares taken up. £2 paid. Mortgages and charges, nil.

United Electric Tramways Company of Caracas, Ltd.—Issue on January 1st, 1931, of £10,000 debentures, part of a series already registered.

Brush Electrical Engineering Co., Ltd.—Issue on March 29th, 1920, of £13,380 debentures, part of a series already registered. (Particulars of issue filed January 16th, 1931.) Satisfaction in full on December 23rd, 1930, of £100,000 prior lien participating debenture stock authorised October 2nd, 1912, and registered October 23rd, 1912.

M-L Magneto Syndicate, Ltd.—Satisfaction to the extent of £80,000 on January 8th, 1931, of debenture dated February 23rd, 1921, and registered February 25th, 1921.

Robinson & Rex, Ltd.—A. W. Eccles, 44, Gray's Inn Road, W.C., ceased to act as receiver on January 12th, 1931.

Marco Refrigerators (1929), Ltd.—Charge on Manor Road Works, Rowan Road, Mitcham, with fixtures, dated January 14th, 1931, to secure all moneys due or to become due from the company to the Westminster Bank, Ltd.

Full Light Anti-Dazzle Lamp Co., Ltd.—P. M. Mordant, 115/117, Cannon Street, E.C.4, ceased to act as receiver or manager on January 15th, 1931, in respect of first and second debentures.

City Notes.

Perak River Hydro-Electric Power Co., Ltd.

This company's report was abstracted in our issue of January 16th, p. 117, and the annual meeting was held on January 22nd. Viscount Elibank (chairman), who presided, in the course of his speech said that in June last the Chenderoh dam and power house were formally inaugurated, and the power house was to-day generating the whole of the supply demanded by their consumers. During the years 1926-1930 a great construction programme had been carried out. At Chenderoh a dam approximately 1,000 ft. in length had been completed, together with a power station in which were installed three water turbine-driven alternators, each with a nominal capacity of 9,000 kW. The dam had cost some £350,000 more than the consulting engineers had originally estimated, largely due to the fact that it had been found necessary to excavate in a part of the river bed to the extent of about 66 per cent. deeper than was anticipated before solid rock was reached. At the southern end of their system they had constructed a steam station containing three 6,000-kW turbo-alternators. The construction of this station had been completed in eleven months. They had erected some 140 miles of overhead transmission lines and thirteen large and important sub-stations. The department established in Perak for preparing schemes for the electrification of dredges, gravel pumps, and the like had achieved so much success that they had contracted for the full output of the steam station within a year of its being put into commercial operation. The fall in the price of tin had upset all their calculations. A complete survey of the location and quantity of machinery on the premises of every power consumer in their area and within reasonable distance of their supply system, however, showed that about 60,000 h.p. represented business which in due course they might reasonably hope to obtain, given a return to prosperity in the tin industry; this was nearly double the capacity of their generating plant and system as at present installed. The board in its last circular intimated the adverse effect which the continuous fall in tin prices was having on the growth of the company's business. In view of the large financial interest of the Federated Malay States Government in the enterprise, and of its voting control, the board had kept in close touch with that Government since April last. The outcome of the negotiations was the scheme of arrangement submitted for the approval of the various classes of debenture stockholders and the shareholders. In the circular dated January 12th it was indicated that it was proposed to issue immediately £200,000 5½ per cent. prior lien debenture stock, and stockholders and shareholders would be given an opportunity to participate. Since then it had been decided that the preferable course was for the company to raise the funds immediately required by bank facilities up to £200,000 secured on a similar amount of stock. Those facilities had been arranged and the question of the offer of stock to stockholders and shareholders was therefore in abeyance for the present. The report and accounts were adopted, and at subsequent meetings of holders of the 5 per cent. guaranteed and 7 per cent. participating debenture stock and an extraordinary meeting of the company, the scheme of arrangement (outlined in our issue of January 16th) was approved.

Cape Electric Tramways, Ltd.

For the first time the annual general meeting has been held in South Africa, the venue being Cape Town on December 30th. The reasons for the transfer of the control and management from London to Cape Town were the saving of British income tax, reduction of London office expenses, and the advantage of having the board on the spot. Mr. Gerald Orpen, the chairman, said that unrestricted and uncontrolled omnibus competition had caused a huge falling-off in tramway revenue, and the omnibuses which they started in self-defence carried a large number of passengers previously taken by the tramways, but at a greatly increased cost. It was unfair and unjust that their competitors should be allowed to pay ridiculously low wages, run to no regular schedule, be under no obligation to repair the damage which they did to the roads, and contribute comparatively little to the rates. The profits of the company from Cape Town and Port Elizabeth tramways up to November 30th were £9,788 and £2,500, respectively, and these had been earmarked for track and car maintenance reserve. No dividend was proposed owing to the uncertainty of the future. In reply to a question, the chairman said that the reserve stood in the books at £793,000. No dividend has been paid for three years.

Singapore Traction Co., Ltd.

The report for the year ended September 30th last shows a profit, after charging debenture stock interest and London expenses, of £57,944, as compared with £51,098 in the previous year, to which is added £3,357 brought forward, making £61,301 available. After providing for debenture stock redemption, depreciation and renewals, &c., there is a balance of £35,725. It is proposed to pay a dividend of 8 per cent., less tax, on the 7 per cent. cumulative preference shares, on account of arrears, while an equal amount (£16,000) is paid to the managers (the Shanghai Electric Construction Co., Ltd.). A balance of £3,725 is carried forward. After payment of the above dividend, the arrears of dividend on the preference shares will amount to 10 per cent. The company now has 24.23 miles of trolley 'bus route in operation. During the year the passenger receipts increased by 12.2 per cent., and so far during the current year the receipts show a small increase compared with the corresponding period of the year under review. Meeting: February 4th.

Companies Struck Off the Register.

The names of the undermentioned companies have been struck off the Register, and the companies are thereby dissolved :—

British Di-Electric Co., Ltd.
Continental & Overseas Wireless Pictures, Ltd.
Electrix, Ltd.
G. Davenport (Wireless), Ltd.
Miller's Radio Products, Ltd.
Motor, Electrical & General Trust, Ltd.
New Union Electric Co., Ltd.
Pondac (Electric), Ltd.
Radio Electric Securities Corporation, Ltd.
Wooldridge Radio Co., Ltd.

Aldershot Gas, Water & District Lighting Co.

The accounts for 1930 show a profit of £55,890, as compared with £60,428 in the previous year. After providing for interest charges, preference dividend and the statutory dividends paid for the half-year ended June 30th, the board recommends the full statutory dividends of £6 1s. per cent. per annum on the "A" stock, £4 11s. per cent. per annum on the "B" stock, and £5 per cent. per annum on the "C" stock for the latter half year, leaving £6,998 to be carried forward.

The annual meeting was held on January 26th. Mr. R. W. Edwards (chairman and managing director), who presided, said that the Electricity Department had shown further development. The advance in sales showed a net increase of 41.6 per cent., while the load rose by 1,533 kW. The price for lighting and other purposes had been substantially reduced during the past year. Rates were an increasing burden on the undertaking, and were the subject of serious consideration. The report and accounts were adopted.

The directors are prepared to receive by February 3rd tenders for a sufficient nominal amount of 4 per cent. consolidated preference stock to produce the net sum of £150,000. The minimum price is £74 10s. per £100 of stock.

Baird Television, Ltd.

The adjourned annual meeting was held on January 27th. The directors state that since the adjournment of the meeting discussions with Messrs. Rowland & Whitcomb, and other representative shareholders, have resulted in the withdrawal of Mr. Whitcomb's motion and the appointment of Mr. Rowland to the board without an increase in the aggregate amount of directors' fees. Mr. Whitcomb had proposed that Mr. Rowland should be elected a director and that two other vacancies on the board should not be filled.

National Electric Construction Co., Ltd.

The directors have received from the British Electric Traction Co., Ltd., an offer for the purchase of the whole of the company's 170,000 10s. shares at 30s. per share, including any final dividend in respect of 1930. The offer is conditional on its acceptance not later than January 27th by holders of not less than 75 per cent of the issued shares or such percentage as the purchasers may elect to accept.

Western Union Telegraph Co.

The gross revenues for the year ended December 31st last amounted to $133,269,598, as compared with $148,449,854 in 1929. The total expenses were $118,901,986 ($129,364,896), and after deducting interest on bonded debt the net income was $9,320,034 ($15,474,893).

Imperial & International Communications, Ltd.

The estimated traffic receipts for the year ended December 31st last were £5,365,561, as compared with £6,146,452 in 1929, a decrease of £780,891.

Westminster Electric Supply Corporation, Ltd.

A final dividend is announced on the ordinary shares of 13.12d. per share, less tax, making the company's standard dividend of 1s. 9.12d. per share for 1930.

Stocks and Shares.

TUESDAY EVENING.

IT is somewhat unusual to be able to chronicle improvements in any Stock Exchange markets other than those devoted to the purely investment and gilt-edged securities. This week, however, a more cheerful note can be sounded in regard to prices of stocks and shares in the various industrial sections. What has brought about the change is the fact that forced selling, which had to come to an end some time or other, is over; at all events for the present. Concurrently, a greater feeling of confidence became manifest in the public mind for investments connected with commercial and trading concerns. Added to these causes is the contributory fact of bear purchasing; and, the markets generally being poorly supplied with stock and shares, the various favourable influences found ground ready prepared for a change in sentiment. The Government, faced with a serious division on the Wednesday in this week, is deemed to be none too firmly settled, and the prospect of any political change adds one more element to the favourable factors that work for advancing prices. New issues continue to attract attention and money.

Investment Stocks.

The London Power 5 per cent. debenture issue, which came out at 100¼, proved a popular success, and the price of the scrip is 1⅛ premium. Allotments made to members of the outside public were extremely small. The price of the previous issue, which stood at 103, has moved up to 104. London and Home Counties 4½ per cent. stock had gone back to a slight discount on the issue price of 95½, but was soon up again to its "par" level. A decline also occurred in Central Electricity 4½ per cent. debenture, but this was recovered too, and the price is now 95½ bid. The 5 per cent. debenture stocks recently issued by the two tube railways, London Electric and Central London, have risen to 105¼, these prices being ex the broken amounts of dividend due on the 1st of the current month. Underground 5 per cent. debenture has hardened to 103. Stock Exchange dealers' lists of stocks on offer show how little can be obtained. The investor of to-day who tries to buy any first-class debenture stock, in practically any department, will find his quest an extraordinarily difficult one, and he is likely to be not a little exasperated by the monotonous reiteration of "no stock" that will meet his inquiry for such investments.

Home Railway Stocks.

The dividend declaration for the second half of 1930 is due this week on Metropolitan consolidated ordinary, and the price of the stock has moved back to 66½, in spite of the anticipation that the previously-paid 4 per cent. for the year will be maintained. If so, this will provide 6 per cent. on the money to a purchaser at the present price. The company had but a moderate advance in traffics for 1930, and will have to meet additional charges on the capital that was raised during the year. Districts, it will be observed, yield about 6½ per cent., and Underground Electric £1 shares practically the same. Market estimates look for a repetition of 5 per cent. for the year on Districts, and 8 per cent. on Underground Electric ordinary.

National Electric Construction and the B.E.T.

London United Tramways debenture holds its improvement at 57½. The preference shares are quoted at 4s. London and Suburban Traction ordinary are 2s. 6d. The British Electric Traction Company has made an offer of 30s. per share for the National Electric Construction Company's 170,000 10s. shares. The offer is conditional on its acceptance not later than the Tuesday in this week by holders in the aggregate of not less than 75 per cent., or such less percentage as the purchasers may elect to accept. The shares have been quoted for some time past at 26s. 3d., the last business marked in them being at 26s. 6d. a month ago. The purchasers, if the deal goes through, will take, of course, any final dividend in respect of 1930. British Electric Traction deferred stock has risen 75, to 1400, and the preferred ordinary, at 136¼, is 2 points up.

Home Electricity Shares.

Egham & Staines continue to provide a good deal of mild interest for those who are following the course of this market. The price touched 40s. 6d., from which it reacted to 39s., leaving it a shilling down on the week. Isle of Thanet ordinary remain dullish at 25s. Metropolitan Electric Supply have gone back to 41s. 3d., in spite of rumours to the effect that the dividend of 10 per cent. may be increased. As the latter rate was an advance upon the 9 per cent. paid in the previous year, caution suggests that retention of the 10 per cent. may be expected. Lancashire Light & Power shares continued heavy, losing another 6d. at 23s. 6d., and Newcastle-on-Tyne ordinary reacted to 23s. 9d. The company's 4½ per cent. debenture is better at 96. The Urban Electric Supply Company has notified the redemption of its outstanding 4½ per cent. debenture stock, which will be effected on July 31st next at 105 per cent. The stock is quoted in the Stock Exchange Official List at 103 middle. The company's 5½ per cent. mortgage debenture stock

stands at 101½, and, if it can be bought at this price, it should make a sound investment.

Cables and Wireless.

The more cheerful tendency which developed in Stock Exchange markets has made little difference, so far, to the prices of Cables & Wireless issues. These will doubtless have their turn if the general markets keep good, because the stocks are standing prices that offer a temptation to the speculative investor who is prepared to wait for better times and better trade. The traffic receipts of Imperial & International Communications are now published for the year 1930, and show a decrease of £781,000, as compared with 1929. The receipts in 1930 come out at £5,365,561, a sum which compares with the £5,405,000, the official forecast made last July for the 1930 period. It is expected that the preference dividend due in March will be duly met. The Western Union figures came, by coincidence, on the same day as those of the Imperial and International Communications, and they tell the same sort of story. The Western Union revenue last year was about 15 million dollars less than in 1929, and the net income fell from 15½ million dollars to rather under 9½ million dollars. Anglo-American Telegraph stocks are ex dividend, allowing for which, the prices are, if anything, rather better on the week. Globe Telegraph & Trust ordinary at 12 reflect the nervousness which is felt in regard to the outlook. The preference receded to 10¼. Marconi Marines are a better market at 38s. 9d., the useful yield which the shares afford serving to direct attention to the company's prospects of maintaining the dividend of 15 per cent. per annum. Great Northern Telegraphs are 10s. lower at 29. American Telephone & Telegraph at 196½ have risen 9 points. Internationals at 27½ are up 3. Automatic Telephones are a good spot, with a rise to 37s. 6d. International Automatics rose in sympathy to 36s. 3d.

Manufacturing and Equipment.

The pressure to sell shares with the intention of thereby raising sufficient money with which to meet obligations incurred elsewhere, has been relieved amongst the issues of the electrical manufacturing and equipment companies. The effect was very marked: a general recovery ensued. Amongst other shares to advance were British Insulated ordinary, Callenders, and G.E.C. ordinary. Edison Swan preference have recovered the dividend announcement. Associated Electrical Industries ordinary put on a shilling at 22s. On the other hand, British Aluminium shares are dull at 27s., showing a drop of 3s. on the week. The company's recently-issued debenture remains a heavy market at 2¾ discount. Crompton Parkinson 8 per cent. preference hardened to 26s. 9d., and British Thomson-Houston 7 per cent. preference to 24s. 3d. No change occurred in Brush stock at 105. In the iron, coal, and steel group, Babcocks further receded to 43s. 9d., but rallied briskly to 47s. on news that the County of London Electric Supply Company had placed a contract with Babcock & Wilcox for boiler plant for the Barking power station in connection with the Electricity Board's great scheme. It is stated that the amount involved will be nearly £700,000, and that the work which this will provide will last for some considerable time. Vickers shares have been put on a few pence at 7s. 1½d. The rubber market peacefully slumbers.

Miscellaneous Matters.

Anglo-Argentine Tramways 5 per cent. debenture stock has fallen 11½ points to 38½ in consequence of the apprehension felt in regard to the financial position of the company. The 4 per cent. debenture stock, and the 4½ per cent. debenture stock, both of which rank before the fives, are quoted at 64. The next interest payment on the last-named stock is due next May. The first preference shares of £5 each are 2s. 6d. down at 25s., and the company's 6 per cent. preference, also of £5 each, last changed hands at 20s. two months ago. The Mexican group moves irregularly. Mexican Light & Power common are 5 points up at 47½, and the preferred is 2 higher at 66½. On the other hand, Mexico Tramways 5 per cent. bonds, at 54½, show a loss of 3½ points, and the shares are down to 10. Perak River Hydro-Electric 7 per cent. debenture stock is quoted 5 lower at 50, the ordinary shares being 2s. The proprietors agreed last week to the proposals of the board for meeting the crisis that has arisen mainly by reason of the slump in tin. The Singapore Traction Company announces a net profit of £58,000, showing a gain of £6,800 on the previous year's figures, and the company proposes to pay a dividend of 8 per cent. on the 7 per cent. cumulative preference on account of arrears. This will leave arrears of 10 per cent. The ordinary shares of £1 each stand at about 7s., the preference being 18s. 9d., and the 6 per cent. first mortgage debenture stock 96½. Melbourne Electric Supply Company is paying a dividend of 10 per cent. free of tax. The price of the stock is 150, the last transaction officially recorded being at 176 on March 10th, 1930. British Power & Light shares shed a few pence, going back to 11s.

Dollar Stocks.

New York has been in better fettle, with the consequence that dollar stocks are harder as a rule. Hydro-Electrics advanced to 25, British Columbia "A" to 37¼, the "B" remaining at 12¼. Shawinigans are dull at 51½. Brazilian Tractions put on 1½ dollars, improving to 24½. Pennsylvania Water & Power recovered to 60¾ after being lower. Para Electric Railway 5 per cent first debenture—a sterling stock—at 62½, shows a loss of 5 points.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Approx. Dividend. 1928.	1929.	Price Jan. 27 1931.	Rise or fall.	Yield p.c.
	£					
Bournemouth and Poole	1	15	15	3⅛	—	4 17 10
Brompton Ordinary	1	8½	8½	27/6	—	5 1 10
Central Electricity 4½% Deb. ...	Stock	—	—	95½	—	4 14 3
Charing Cross Ordinary	1	8½	8½	29/-	—	4 16 7
Chelsea	1	8¼	8¼	27/6	—	5 1 10
City of London	1	10	10	36/3	—	5 10 3
Clyde Valley	1	8	8	34/6	—	4 12 9
County of London	1	7	10	48/9	—	4 2 0
Edmundsons' 7% Pref.	1	7	7	25/6	—	5 9 10
Elec. Supply Corporation	1	11	11	48/9	—	4 1 0
Kensington Ordinary	1	8	8	28/4	—	4 18 3
Lancs. Light and Power	1	7½	7	23/6	—6d.	5 19 2
London & Home Counties 4½% Deb.	Stock	—	—	95½	—¼	4 14 3
London Electric	1	8½	9	32/6	—	5 10 9
Metropolitan	1	9	10	41/3	—9d.	4 17 0
Midland Counties	1	6½	7	28/6	—	4 18 3
Mid. Elec. Power	1	15	8	31/3	—	5 2 5
Newcastle-on-Tyne Ordinary ...	1	6	6	23/9	—9d.	5 1 1
do. 7% Pref.	1	7	7	27/6	—	5 1 10
Notting Hill 6% Pref.	10	6	6	11½	—	5 6 8
North Met. Elec. 6% Pref. ...	1	6	6	24/-	—	5 0 0
St. James' and Pall Mall	1	8	8	28/-	—	5 0 0
Scottish Power	1	8	8	30/-	—	5 6 8
South London	1	8½	8½	27/6	—	5 1 10
Urban Ordinary	1	7	7	29/6	—	4 15 0
Westminster Ordinary	1	8½	8½	29/-	—	4 16 7
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	25/6	—	5 17 8
Yorkshire Elec.	1	8	8	34/6	—	4 12 9

HOME RAILS.

Central London Ord. Assented ...	Stock	4	4	79	—	5 0 9
Metropolitan	,,	3½	4	66¾	—⅛	6 0 5
do. District	,	4	5	77	—	6 9 10
Underground Electric	£1	7	8	24/6	—	6 10 8
do. do. Income ...	Bonds	6	6	104	—	5 15 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	102½xd	—	5 17 1
do. Def.	,,	1½	1½	2¼xd	+⅜	5 18 10
Automatic Telephone	1	10	12½	37/6	+1/16	6 13 4
Cables & Wireless 5½% Pref. ...	Stock	—	5½	66⅜	+1	8 5 4
do. A 7½% Ord.	,,	—	—	20⅛	—	... ...
do. B Ord.	,,	—	—	10⅛	+⅛	... ...
Globe Tel. and T. Ord.	10	10	10	12	—	8 6 8
do. do. Pref.	10	6	6	10¼	—¼	5 17 1
Great Northern Tel.	10	20	20	29	—⅜	6 18 9
Marconi-Marine	1	12½	15	38/9	+1/16	7 14 8
Oriental Telephone Ord.	1	12	12	2⅜	—	*5 1 1

HOME AND FOREIGN TRAMS, &c

Anglo-Arg. Trams First Pref. ...	5	5½	5½	1¼	—⅛	... ...
do. do. 2nd Pref. ...	5	6	6	17/6	—	... ...
do. do. 5% Deb. ...	Stock	5	5	38½	—11½	13 0 0
British Electric Traction Def. Ord.	,,	5	5	1400	+75	... ...
do. do. Pref. Ord.	,,		8	134½	+2	5 19 0
Brazil Traction	100	7	8	21½	—1½	... ...
Brit. Columbia Elec. Rly. Pce. ...	Stock	5	5	96½	—	5 3 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	11/6	—	... ...
London United Tram Deb. ...	Stock	4	4	57½	—	6 19 2
Mexico Trams, 5% Bonds ...	—	5	5	54½	—3½	9 3 6
Mexican Light Common	100	Nil	Nil	47½	+5	... ...
do. 7% Pref.	100	7	7	66½	+2	10 10 0
do. 1st Bonds	—	5	5	80	—	6 5 0
Victoria Falls Ord.	1	15	15	58/9xd	+6d.	5 2 0
Yorkshire (West Riding)		Nil	Nil	5/6	—	... ...

MANUFACTURING COMPANIES.

Assoc. Elec. Ord.	1	6	6	22/-	+1/-	5 9 1
Babcock & Wilcox	1	13	15	47/-	+2/-	*6 7 8
British Aluminium Ord.	1	10	10	27/-	—3/-	7 8 0
British Insulated Ord.	1	15	15	3 5/16	+⅛	4 10 7
Brush Ord.	Stock	10	10	105	—	9 10 6
Callenders	1	15	15	3 5/16	+1/16	4 16 1
do. 6½% Pref.	1	6½	6½	25/-	—	5 4 6
Crompton Parkinson Ord.	5/-	—	30	21/3	—	7 1 2
do. 8% Pref.	1	8	8	26/9	+6d.	6 0 0
Edison-Swan 1st Pref.	1	7½	7½	23/9xd	+6d.	6 6 4
do. 5% Deb.	Stock	5	5	92½xd	—	5 8 1
Electric Construction	1	5½	5	12/-	—	8 6 8
Enfield Cable Ord.	1	20	25	4¼	—	5 17 8
English Electric	1	Nil	Nil	10/-	—	... ...
do. do. Pref. ...	1	3	Nil	8/9	—	... ...
Ferranti Pref.	1	7	7	21/6	—	6 10 4
G.E.C. Pref.	1	6½	6½	25/6	—	5 2 0
do. Ord.	1	10	14	45/-	+6d.	6 4 6
Henley	1	25	30	5⅜	—	5 4 6
do. 4½% Pref.	5	4½	4½	4⅜	—	5 2 10
India-Rubber	1	Nil	Nil	6/3	—	... ...
Johnson & Phillips	1	10	10	36/9	—	5 8 10
Siemens Ord.	1	7½	7½	1 1/16	—	7 1 2
Telegraph Construction	12	10	10	16½	—	*7 5 6

*Dividends paid free of Income Tax.

The Indian Trade Situation.

The author, who has had several years of commercial experience in India, points to what he considers to be weaknesses in British methods and suggests remedies.

By L. NEWTON DAVEY.

UPON reading the statistics and your editorial comments on the Indian trade situation in the ELECTRICAL REVIEW of November 7th, I was tempted to write as Mr. Acland has done, but instead I adopted the expedient of utilising your "Situations Wanted" columns, coupling a reference to the subject with an offer of my services. The totally barren results of this procedure and a sincere wish that the expression of my views will benefit British manufacturers as well as possibly myself lead me to write now.

I think that much of our trouble in the Indian market must be due to lack of appreciation in England of the conditions that obtain in that country. As a result, economy is frequently misapplied and the time for enterprise misjudged. Unsatisfactory results are as often attributable to a paucity of representation as to the leanness of the market, and staff reduction in these circumstances produces a fatal wasting disease. Judicious enterprise is as essential as economy in times of depression. The investigations that a dwindling turnover demands, usually disclose a need for reduction in certain administrative and productive departments, but justification can rarely be found for more than a weeding-out of the sales staff, as the maintenance of its steady activity is generously rewarded immediately conditions improve. Relax this vigilance and a germ—a competitor's first order—enters and plays havoc with the business system.

A Smaller Share of Larger Businesses.

All this is particularly appropriate to the situation in India as it exists to-day, with the boycott of British goods as the weapon being wielded to further the cause of politicians. This impediment to British trade is serious enough, but it would be far worse were it not that India knows British goods and, appreciating their value, demands them. Even so, our position is far from impregnable, and we should resist the coercion of politicians and the encroachments of our national competitors by tactful but persistent activity. British exports to India were 65 per cent. of the total in 1914. They have now dropped to 43 per cent. and a lethargic attitude in the present circumstances will aggravate this wasting to a state from which it will take many years and much expense to recover. With a population of 370 millions and the extensive development now taking place in the country, no manufacturer can afford to ignore the Indian market. We have touched only the fringe of its possibilities so far as the electrical trade is concerned, for whilst most residences and offices worthy of the name are, where a supply exists, electricity consumers, for every one connected building there are scores of small bazaar premises and Indian dwellings which remain potential consumers. The flourishing state of the undertakings now springing into existence all over the country proves that the Indian is alive to the amenities of electricity and, when given facilities, will adopt it for both domestic and industrial purposes. The business bred of this development reaches the manufacturer through a variety of channels, which can be divided into three main classes: (*a*) The Indian Stores Department; (*b*) Other Government, public and State authorities; and (*c*) The bazaar dealers and contractors.

The activity of the I.S.D. covers business ranging from projects involving crores of rupees to the purchase of small stores by yearly or petty contract. The significance of the business is not limited to the value of goods supplied, as I.S.D. selections are interpreted by many authorities, and a large section of the public, as a hall-mark (of value, if not quality) and have considerable bearing upon general business also. It is imperative, therefore, that the goodwill of the Department should be cultivated and a share of its contracts secured, but under its revised rules of operation this is practically impossible without local representation. The second class is composed of unit business sources, each requiring individual treatment and representing sporadic business. The third class—the bazaar—ranks high in importance with the manufacturer, as it represents his most valuable and stable customer—the public—upon whom all industries are directly or indirectly dependent.

The Selection and Supervision of Agents.

As Mr. Acland points out, the arrangement of representation presents many difficulties. Branches can only be justified in the case of concerns with an extensive range of interests productive of a large turnover. The alternative of agents frequently leaves much to be desired. Suitable houses of standing are probably already committed to a competitor, are unsuitably staffed, or are confined to a limited area of activity. India is a country composed of an infinite variety of communities demanding individual understanding; but it is a vast territory, the touring of which is time-wasting and expensive, and this factor restricts branches and agents to an area of economic radius from their centre. The establishment of a branch or agent, therefore, does not necessarily solve the problem of securing comprehensive representation. And here lies the crux of the situation. The best cannot be had from the Indian market without a system of representation covering the whole country.

Any attempt to arrange and control from England separate agents in each centre would prove a waste of time, money and opportunity. Apart from such a system being unwieldy, many dealers lack initiative and energy, some lack scruples, and most of them allow their enthusiasm to envelop them in a vortex of unjustified price-cutting. Ambitious dabblers are as prolific as the mosquito and lavish promises and useful initial orders present no difficulty when an attractive agency is the prize. Further, owing to the patriarchal constitution of many Indian business houses, a concern prosperous one day may, through the death of a partner or its principal, be a chaotic wreck the next. Caution is therefore the password with which to enter the Indian market, and the manufacturer must place himself in a position to exercise the necessary supervision and provide the enterprising assistance that is so encouraging to any type of agent.

Formidable as these difficulties may seem, they need not preclude the small manufacturer from his share of the Indian business, for most Indian dealers have an innate commercial acumen and when treated with understanding prove staunch friends and form excellent material with which a manufacturer can build outlets for his products. The writer has, during eight years in India, experienced the satisfactory results that can be secured by organising the more reliable dealers into a system of supervised distributors. This form of representation is particularly suitable for the manufacturer of limited means and interests, as although it incurs no greater expense than a competent representative with a centrally situated office and nucleus staff, it provides all the features necessary properly to exploit the market; and while this policy is in keeping with the topical sentiment of India for the Indian, it preserves for the manufacturer full jurisdiction over an organisation extending throughout the country and equips him for the efficient handling of I.S.D. and other important business

Energy and Adaptability Needed.

In view of the vicissitudes of the market, much depends upon the representative, and principals should select their men with discretion, as a representative's job in India is emphatically not the sinecure it is believed to be by so many here at home. Too frequently the man sails, full of self-importance but equipped with little more than a few order books, his golf clubs, a tennis racquet and a gun for the tiger which he hopes to bag. The voyage out, and the high standard of hospitality which he enjoys on arrival in Bombay, fully justify his belief that the white man's paradise lies East of Suez. Dinner parties, golf, tennis, shooting expeditions, moonlight picnics, bridge—these are the activities, punctuated by abbreviated spells of work, that *may* form his routine. But the man with his heart in his job will not see his club, where the evening leisure hours are spent, from one month's end to the next. He will find his visions of big orders collected with an elbow on the club bar counter transformed into realities of days spent sweltering in trains or in unwholesome bazaar hovels, too often rewarded only by disheartening procrastination. He will find himself in his office at 8 p.m., glad of the quiet produced by the staff's departure to get down to the things that really matter. He will miss ready access to his chief, and probably find the responsibility of decision in the matter of administration and policy weighs heavily.

It should not take him long to appreciate that the business that he has to negotiate in India is negotiated by India for the Indians and that his success depends upon his ready adaptability to unusual and unexpected circumstances. The days of the wet-nursed Indians are over; they are standing on their own feet negotiating their own business, and while many are as westernised as a London-born Scot, gentlemen to their finger-tips, others are illiterate and crude. Yet this does not qualify their wealth or value as potential customers, and a representative must be capable of exercising tact and patience in emergency and of coupling hard-headed resourcefulness with a sympathetic and generous mind. These are not merely desirable qualifications but essential characteristics for the representative who is to secure proper results for his employer. While education and good bearing are of considerable value, the Indian is exceedingly responsive to courtesy and tactful handling, and the personality of a less technical man has robbed many a specialist of coveted orders.

An aim at economy probably accounts for the youth of many "first trippers," but it takes a long-headed youth to withstand the lure of the innumerable social diversions that the country offers. A man of more sober years and commanding greater deference proves the better investment, particularly for appointments of this nature where he must be: A competent sales organiser, exercising tact and good judgment in the selection and supervision of his distributors; a responsible representative capable of negotiating with the I.S.D. and other important authorities; and sufficiently technical to discriminate between superficial criticism and legitimate complaints, discharging the former and passing the latter to his principals with constructive advice.

The Representative's Advice.

The value of the whole scheme is, of course, negated if the representative's advice on local requirements is not, or cannot be, accepted by his principals. To send a man to a country 6,500 miles away with inflexible instructions as to policy, terms and selling prices sounds, and is, ridiculous, but it is not uncommon. No manufacturer can ascertain in this way the volume of business to be secured from the market; and until the volume is known the effect of the market upon his output and production costs cannot be determined and without this information there is no true basis for selling prices. If he is not actually consulted regarding design, when his experience indicates that modifications are necessary to suit local conditions, his recommendations should be adopted if at all possible. A manufacturer persisted in using fibre wedges because they were "standard in England"—and paid the penalty of being ostracised by one of the foremost authorities!

Judicious advertising can do much to overcome the difficulty of arranging personal contact. The Indian public is nothing if not impressionable, and dealers, although normally apathetic towards other than established lines, are stirred to active interest by the encouragement of propaganda. Many media of varying value are available and much use can be made of certain vernacular papers. These have the advantage of being comparatively inexpensive. Window displays, the very finest form of appeal to the Indian public, appear to have been neglected by manufacturers and this is where the representative could work magic. One window display in each centre would have the country agog and bring the whole community of dealers clamouring for agencies.

Except for the efforts of a few enterprising supply companies—which, incidentally, have reaped their just reward—little has yet been done to educate the Indian public into the idea of the Electric Home. We have our organisation in the E.D.A. Why not expand its scope, expand our output, reduce our production costs and place ourselves on a more competitive footing at home and abroad by instituting a campaign in India? Such a campaign must come. From our point of view, both politically and industrially, there never was time like the present. Let it come now, and—let it be British!

Mr. Morrison's Campaign.

Discussions in Glasgow, Manchester and London.

THE first three of the five conferences of representatives of electricity supply undertakings convened by the Minister of Transport (**the Rt. Hon. Herbert Morrison**) were held in Glasgow, Manchester, and London last week.

On each occasion the proceedings opened with an address by Mr. Morrison couched in the following terms:—The Government had devoted much attention to encouraging the better organisation and re-equipment of industry to increase its effectiveness when trade improved. Economic preparedness was particularly applicable to the electricity supply industry, and it was the duty of those responsible to make themselves ready to meet the much heavier demands which would arise in the years immediately ahead. In spite of industrial depression the industry continued to progress and it was still far from the saturation point, especially in the domestic field. He urged that all undertakings operating in urban areas should consider the practicability of completing their distribution networks in all of the built-over areas during the next two years. "The existence of the Main in the Street will exert a strong influence on the Man in the Street." There were still many miles of streets containing potential consumers where no mains had been laid and many other districts in which cables suitable only for a lighting load had been installed. Mr. Morrison also pointed to the advantages of changing-over non-standard systems of supply to the standard, in which direction much remained to be done. He particularly stressed the ultimate saving to all branches of the industry and to the consumer. He strongly endorsed the views which had been expressed by the Electricity Commissioners upon the necessity for the institution of schemes for assisted-wiring and the hiring or hire-purchase of apparatus, showrooms, and an active publicity campaign.

Another important question was the revision of tariffs and charges. In respect of domestic supplies all undertakers should adopt a reasonable two-part tariff with the lowest possible "unit" charge to encourage the maximum use of electricity for all purposes. In the present depressed condition of industry it was also very necessary that power for industrial purposes should be supplied at the lowest possible rates. The cultivation of the feeling that the supply undertaking existed to serve and not merely to make money was not only right in itself; it was sound commercial policy. In a sense, somebody in the supply undertaking should be available as a free consulting engineer to all classes of consumers. The consumer should actually be taught how to save electricity by proper use to induce him to see that electrical service was cheap. The Government was anxious to afford undertakings financial assistance in these developments by means of the Development (Loan Guarantees and Grants) Act, 1929, where assistance was economic and justifiable, but it was no part of the Government's policy to spoon-feed industries which could and should help themselves. The industry was in an extremely favourable position to offer a remunerative outlet for a large amount of additional capital expenditure during the next few years, and he urged every authorised undertaker to put in hand the largest possible amount of work in anticipation of the developments which were bound to come so as to give an immediate stimulus to employment and trade.

The Glasgow Conference.

At Glasgow, on January 19th, the Minister was supported by representatives of the Electricity Commissioners, the Central Board, the I.M.E.A., the Incorporated Association of Electric Power Companies, the Provincial Electric Supply Association, E.D.A., and the E.A.W.

Lord Provost Kelly took the chair, and after Mr. Morrison had addressed the meeting, a discussion was initiated by **Councillor Walker** (Edinburgh). He claimed that Edinburgh and Glasgow had carried out most of their "anticipatory" work, but no doubt there were other schemes of extension which could be carried out if grants could be secured. The charges in the two cities were about as low as anywhere in the country. He was not too sure of the ultimate success of hire-purchase, and did not consider it the best means of stimulating the sale of electricity; they had not adopted assisted-wiring in Edinburgh because there had been no demand for it.

Dean of Guild Robertson (Clyde Valley Electrical Power Co.) said that his company would give Mr. Morrison the fullest support. From the first the company had been particularly progressive; it had spent £500,000 before it had a single consumer on its books, and £700,000 before it made a profit. The agricultural demand in the area had been disappointing. He agreed with Mr. Morrison regarding the benefits of assisted-wiring. The company now had schemes in prospect which would mean an expenditure of about £200,000. Although relief had been obtained from restrictive regulations they must have still further reductions in the cost of distribution. Cheap electricity for industry was essential if they were to compete with private plant. He also drew attention to the heavy burden of rates which in his company's case absorbed 10 per cent. of the gross receipts. The relief of manufacturing industries from 75 per cent. of their rates had imposed a further handicap upon the electricity supply industry which might have disastrous results. Another severe blow to the industry was the higher price which it would now have to pay for coal.

Bailie McDonald (Buckie) hinted that his town, which had only secured its Electricity Order a fortnight before would require a grant. **Mr. Roy** (Wick) complained that there was too much red tape attached to the granting of assistance to undertakings. **Mr. H. C. Babb** (Lothians Electric Power Co.) mentioned wayleave difficulties and also suggested that new undertakings should be exempted from rates for a period of five years. **Mr. Orr** (Hamilton) complained that wages and salaries in the industry were too high.

In his reply **Mr. Morrison** said that he frankly believed that the industry could help itself and did not need subsidising. The policy of anticipating the future demand was commercial enterprise. If, however, the expense of the accelerated laying of mains was likely to be a burden, assistance might be given. His experience had been that where a hire-purchase scheme had been adopted there had been great expansion, as in Glasgow. He thought that undertakers would have to regard rural supplies in much the same way as the Postmaster-General regarded rural letters. He agreed that in the matter of derating, the industry had been treated unjustly, and the perpetuation of the private plant, which he deprecated, had been encouraged.

Discussion at Manchester.

At Manchester on January 20th, Mr. Morrison was introduced by the Lord Mayor of Manchester (**Alderman Titt**). After Mr. Morrison had delivered his address, **Mr. Frank Wilson**, chairman of the Liverpool Electricity Committee, opened the discussion. He said that it was perfectly well known that the greater the electrical development the lower the cost would be. There were people who preferred electricity but refrained from installing it because they thought that it was much dearer than gas. Again, there were many would-be consumers who were afraid to pay the installation charges. It was necessary, therefore, to institute assisted-wiring systems. At Liverpool they had just completed the erection of a new generating station at a capital expenditure of £1,760,000. In the construction from six to seven hundred men were employed. In addition to this there was the labour necessary for the construction of the materials. Liverpool had also recently spent £400,000 for the purpose of laying new and additional mains, and during the last 18 months 389 rural consumers had been connected up on the overhead wiring system. Liverpool was changing over from d.c. to a.c. Government assistance was necessary in large electrical developments because of the considerable initial outlay. In Liverpool there were 257 all-electric Corporation houses and the average cost for electricity was 7s. 1d. per week per house.

Mr. C. D. Taite, chief engineer of the Lancashire Power Company, complained that no de-rating relief was given to the public supply companies. This, he said, seemed to encourage the provision of private plants. The amount of plant installed in public supply undertakings during the years from 1920 to 1928-29 was in excess of that put down for private supply; last year, however, the position was apparently reversed. His company was connecting up all classes of people now and the charge ranged from 1d. to 0.65d. per kWh. A further difficulty was encountered in obtaining sanction for the use of overhead wires. Another matter was the cost of the slot meter; manufacturers must endeavour to lower their prices. Standardisation of tariffs for public consumers was very necessary.

Mr. Morrison agreed that it seemed unjust that the private plant should be de-rated to the extent of 75 per cent. when the public supplier obtained no remission at all.

Alderman Beale (Birmingham) said that it was difficult to find a scheme that was going to be commercially sound. Birmingham had spent £500,000 per annum on mains extensions and most of that capital was at present lying unremunerative or very slightly so. Applications came in at Birmingham at the rate of at least 40 to 50 per day for the assisted wiring scheme and this was commercially unsound. They wanted to work on this basis, but there were difficulties in front of them. This year receipts were lower for the first time. In conclusion, he said that the electrical industry was busy but not prosperous.

The London Conference.

The **Lord Mayor of London** opened the Conference at the Guildhall on January 23rd. Mr. Morrison was supported by representatives of the Central Board, the Electricity Commissioners, and several electrical associations.

The discussion initiated by Mr. Morrison's address was opened by **Mr. W. F. Marchant** (London and Home Counties Joint Electricity Authority), who said that his Authority had prepared two schemes of development. The first would be put in hand as soon as sanction was received, and it represented what it was believed would be a remunerative scheme. For the second scheme it was hoped to obtain assistance under the Development Act and it was one which his Authority regarded as absolutely indispensable if the supply of electricity was to be equal to the demand which would inevitably arise when the national grid was fully at work. The prosperity of the supply industry depended upon the competitive value of the "unit" and about that some were not too happy at the moment. The Government had imposed a tremendous liability upon the industry inasmuch as the interest on the money required for the grid scheme had to be found by the industry, although it was hoped that this would be turned into an asset eventually. At the same time it was necessary for the Government to give the same support to distribution as it had given to generation and transmission, otherwise the two sides of the scheme would not properly balance. There were difficulties in the London area in that there were differences between the financial positions of the London companies and the extra-London companies with regard to standardisation. There was also a difference in the financial position of the local authorities and companies generally, and he suggested that the Government should appoint a Committee to advise on the difficult subject of expenditure upon standardisation.

Mr. J. C. Dalton (Provincial Electric Supply Association) said that the companies in the Association had inaugurated schemes of development during the past few years. He mentioned that the total capacity of the power plant in industry in this country was 16,000,000 h.p., but only 50 per cent. of that was driven electrically. Experience had shown that the nations which had electrified their industries to the greatest extent were the most successful in the world's markets, but unfortunately trade depression in this country had put a brake on the change from steam to electric power, notwithstanding that in many cases this would mean turning a loss into a profit. Whilst not advocating that the Government should finance the electrical industry he suggested that it should assist the manufacturer to adopt electric driving.

Alderman E. Huntsman (President of the British Electrical Development Association) commended the suggestion of the Minister that supply authorities should spend money in advance of their requirements, and suggested that the E.D.A. should be more adequately supported by all sections of the industry in order that it could more effectively play its part in the education of the public.

Councillor W. Fowell (Fulham Electricity Committee) called attention to the need for 1s. slot meters above 20-A capacity—which were not now available—and asked for legislation which would compel landlords to allow their tenants to have electricity installed on the hire-purchase system, together with other legislation which would prevent profits from electricity undertakings being used for the relief of the rates. He believed that if all profits were made use of in the undertaking substantial reductions in charges would often be possible.

Mr. Fippard (Edmundsons' Electricity Corporation, Ltd.) asked for further compulsory powers with regard to wayleaves as a means of stimulating development.

Mr. W. A. Turnbull (borough electrical engineer, Aylesbury) referred to the fact that his Corporation had electrified the whole of its local and rural area; it asked for some easing of the regulations with regard to the construction of secondary h.p. overhead lines, and urged that supply authorities should be spared the delays due to the departmental system associated with supply at the present time. Farmers had no money and needed assistance if they were to go in extensively for electrification. Some assistance should also be given supply authorities which had commenced rural schemes in fitting up completely-equipped farms in order to demonstrate what could be done. It would be necessary, he suggested, to have the same form of nationalisation of distribution that had been applied to generation and transmission.

Councillor W. Hebden (Shoreditch Electricity Committee) considered that some financial assistance should be given to supply authorities in increasing the capacity of existing mains. If the supply authorities had to meet this expense they would have to postpone reductions in charges which would hold back development.

Mr. A. W. Barham (borough electrical engineer, Watford) said that one of the most important ways in which supply authorities could be assisted to reduce charges was for them to be given the benefits of the de-rating scheme. In most cases the rates were equivalent to £1 per kW and this put the local supply authority out of competition with private plants of 200 kW or more.

Mr. Hesketh (Folkestone Electric Supply Co.) suggested with regard to the standardisation of voltages that if places like Folkestone, where the declared pressure was 210 V, were allowed to increase at the rate of 1 per cent. per annum over a period of five years it would be a simpler and less laborious and expensive process than the present method.

Mr. Wilson (Ashford U.D.C.) spoke of the need for further facilities with regard to "fringe" orders and greater security of tenure in connection therewith.

Councillor Winn (Islington Borough Council) urged that supply authorities should be allowed to spend the profits from their undertakings in development work instead of having to apply to the Commissioners for loans for this purpose, the interest on which meant higher charges to the consumer than would otherwise be necessary.

Mr. G. Porter (borough electrical engineer, Worthing) said that many small undertakings like his own were reaching the limit of the capacity of their generating plant and were unable to get from the Central Board the supplies necessary to meet the demand, and yet they were not permitted to extend their plant. He asked the Minister to bring pressure to bear upon the Central Board to expedite its schemes.

Councillor Green (West Ham) urged manufacturers to reduce the price of electrical apparatus as a means of stimulating demand.

Mr. Morrison, replying to the discussion, asked that all technical matters raised should be brought specially to the notice of the Electricity Commissioners and the Central Board by those concerned. He emphasised the point, however, that the Government had not financed the grid system, although some speakers seemed to think that it had. The only financial assistance had been in regard to the standardisation of frequency on the North-East Coast which was regarded as a special difficulty. He was not sure that he agreed with the suggestion of appointing a Committee on standardisation. He had thought that everybody was reasonably clear regarding what the standards should be and he did not like the idea of appointing Committees needlessly because it would involve delay. He had a good deal of sympathy with supply authorities in the matter of wayleaves, but unless this question was handled carefully they might get into a worse position than the present one. Applications for assistance in increasing the capacity of mains would be looked into if made in the usual manner. Finally, Mr. Morrison expressed his sympathy with the supply industry's position under the de-rating scheme, for which he disclaimed responsibility.

Physical Society's Exhibition—III.

Annual Display of Electrical Instruments and Scientific Apparatus.

Cambridge Instrument Co., Ltd.

One item of this extensive exhibit was a radio thermal milliammeter for a.c. measurements accurate within one per cent. at frequencies up to ten million cycles per second. It consists of a double-pivoted moving-coil galvanometer with a self-contained vacuo-junction, the special feature of the latter being that the thermo-couple is electrically insulated from the heater, and hence neither of the disturbing influences of capacitance and inductance are introduced into the circuit.

Another item was a vertical-force magnetometer which was exhibited jointly with E. R. Watts & Son, Ltd.; the system is supported on knife edges perpendicular to the magnetic meridian, the tilt being measured by viewing it through a telescope fitted with a micrometer eyepiece and it is directly proportional to vertical intensity.

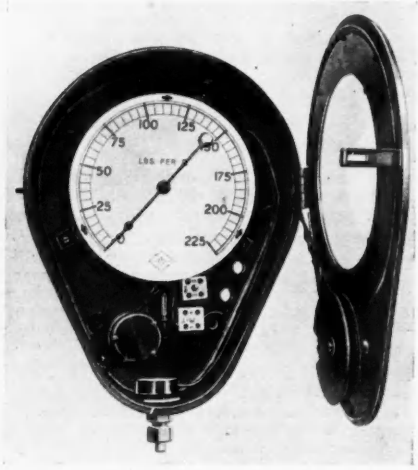


Fig. 1.—Distance Pressure Indicator.

The distance pressure indicator shown in fig. 1 is an application of a principle similar to that of Dr. Shakespear's well-known hot-wire katharometer. The small movement to be measured or recorded moves the mid-point of a small helical spring in the direction of the axis; the coils on one side are, therefore, opened out, and those on the other side closed up; the halves of the spring form two arms of a Wheatstone bridge and their consequent unequal cooling throws the bridge out of balance. The galvanometer gives a thousandfold magnified reading of the original movement, and in this particular application the hot-wire micrometer is fitted to the end of a Bourdon spiral which is subjected to the usual movement with alterations of pressure.

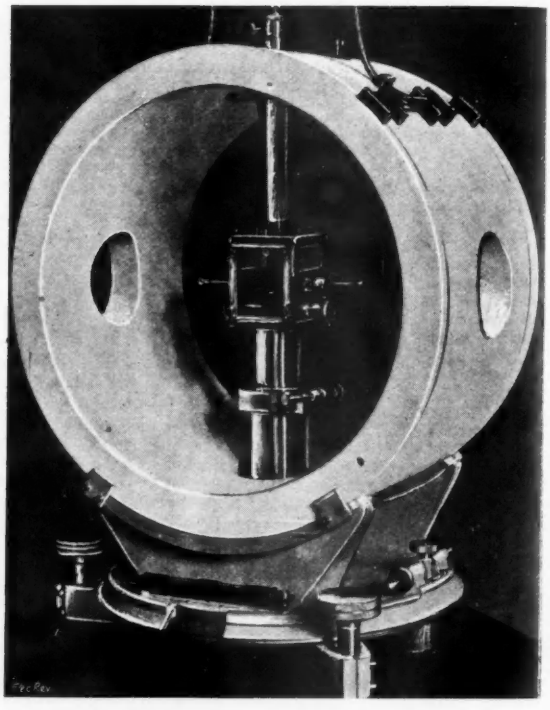


Fig. 2.—Improved Magnetometer.

A new tachometer depends upon a system of contacts, whereby with each revolution of the shaft a condenser is charged from a battery and then discharged through the indicator. The deflection of the latter is proportional to the total quantity of electricity passed through it, which is in turn proportional to the number of contacts made in a given time.

An entirely new system of electrodes has been designed by Mr. C. Morton for use in conjunction with hydrogen-ion

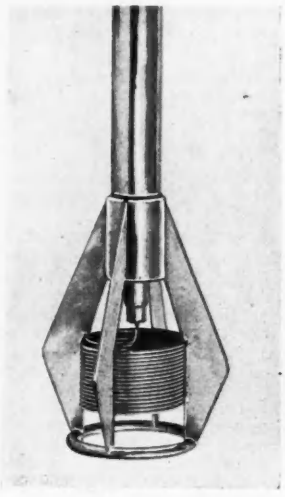


Fig. 3.—Distance Thermometer Head.

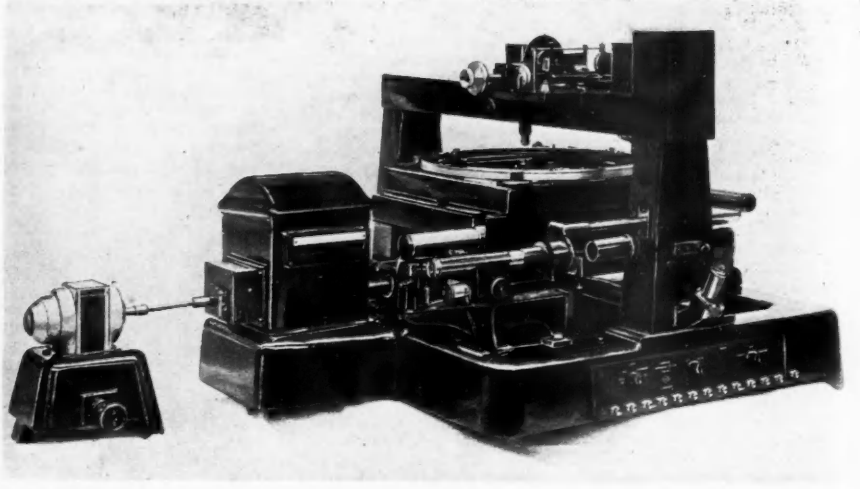


Fig. 4.—Recording Microphotometer.

recording apparatus suitable for industrial use; they require very little attention.

The company has recently developed a new element which may be used in connection with its electrical distance thermometer outfits, whose accuracy is independent of the distance separating the measuring points from the indicator. Measurements depend on the variation with temperature of the electrical resistance of a coil of platinum wire suitably encased (fig. 3) and indicated by a galvanometer which embodies a modification of the Wheatstone bridge. The new quick-reading element responds with steady readings about four seconds after the insertion of the thermometer, and small temperature changes are instantly registered; the range of the indicator scale may be reduced to about 20 deg. F., giving very open graduations. Elements of this kind were fitted recently on the ill-fated airship R.101 for recording atmospheric temperature variations.

A recording microphotometer (fig. 4) has been designed for the study of photographic negatives, particularly those of line spectra, photo-electrically by passing a narrow beam of light

Fig. 5.—Small Moving-iron Voltmeter.

through the negative under investigation. The photo-electric current so produced is proportional to the light falling on the cell, which is a measure of the density of the plate at the point under test. A second cell, used as a Koch resistance, is connected in series with the recording cell and the potential drop across it due to the photo-electric current is applied to the needle of a Lindemann electrometer. An image of the latter's needle is projected on to a drum camera which is revolved at a speed bearing a fixed ratio to the rate of travel of the plate. Thus the position of the needle, which is an index of the plate density, is recorded photographically. "Osram" photo-electric cells are used.

Sir Arthur Schueter's method of measuring the horizontal intensity of the earth's magnetic field has been elaborated by Sir F. E. Smith and has resulted in a magnetometer being made on the Helmholtz-Gaugain system. The coils are wound on a marble cylinder (fig. 2), the axis of which is in a horizontal plane, but the coil can be rotated about a vertical axis on a turntable, the base of which is provided with a 16-in. diameter circle graduated in degrees and subdivided into 10 minutes of arc. Situated at the centre of the coil is a small brass box wherein is suspended the moving system, with plate-glass sides, and on the top is a glass tube to accommodate the quartz suspension and torsion head. The cylinder is made of Marmora marble and in each of two channels cut near its ends twin spiral grooves are cut to accommodate the coils; there are thus four coils, each consisting of five turns of wire, and by means of connecting links either two or four coils may be used. The moving system is made of a single sheet of aluminium foil, cut to leave a frame with V notches near the top; the lower portion functions as a damping vane; the V notches carry the small magnet, above which is mounted a mirror.

For automatic telephony it is essential that under certain conditions the operation of six relays should be simultaneously recorded; for such purposes a six-element oscillograph has been developed similar in principle to the three-element type, but the illuminating and optical arrangements have been modified to obtain the best results from the six vibrators. The apparatus has the sensitivity of the original Duddell design, but possesses additional features which render it suitable for investigations at telephonic frequencies as well as for routine tests in the laboratory or workshop. The vibrators are of the Duddell type, mounted in individual oil baths between the poles of an electromagnet, and may be independently operated or replaced. Each is protected by a fuse and controlled by a switch which enables its polarity to be reversed. Of the six elements, the centre two are for the lower-frequencies and the four outer ones are for high-frequency. A metal cover prevents extraneous light reaching the vibrators when a record is being taken and a camera of the rotating-drum type is fitted, which can be run at speeds up to 1,500 r.p.m., when the peripheral speed is 686 metres per minute. The shutter is electromagnetically operated through an adjustable contact device on the camera-driving spindle, the contacts being so set as to utilise the whole length of photographic material in either one, two, or four exposures, as desired. Independent visual observation of the phenomena under investigation is possible up to the time of taking a photographic record. Any one of the vibrators may be used as a timing device to calibrate the record, but, when all six are required for recording, an electrically-maintained tuning fork will time-mark the record.

Ferranti, Ltd.

This selection of measuring instruments included a moving iron type (fig. 5) that is thought to be the first of its size to have the long scale arc of 110 deg. and a scale length of 2¼ in. Its accuracy is first grade on a.c., whilst on d.c. it is nearly as good. The torque is unusually high, being equal to that used in the moving-coil instruments. Consumption is low and a voltmeter of range 160 volts or above consumes only about 4.6 milliamperes. They are internally shielded against magnetic fields and the damping is such that the pointer comes to rest (under B.E.S.A. conditions) in one second. Regarding electrostatic voltmeters, the lowest range at present produced is 450 volts, the scale being subdivided from 100 V upwards; other ranges extend to 3,500 volts. They are internally protected from damage by an accidental over-voltage; damping is magnetic and a special design of inductor conduces to continued accuracy, as the possibility of deformation is reduced. A phase-rotation indicator of small size (3 in. diameter) and light weight (9 oz.) is rated at 40-500 volts, 50 cycles, and with slightly altered lowered values will serve equally well on other frequencies; the standard vector rotation is adhered to.

A feature of the F-type balanced-armature relay used for protective purposes is the employment of a patented "automatic shunt." Surges due to switching-in and various high-frequency disturbances are not required to operate the protective gear; the function of the shunt is to reduce the sensitivity to high frequencies whilst maintaining the original sensitivity for the fundamental frequency, and it is also very effective for third harmonics. It passes increasing current as the frequency rises, hence less current is available for the relay coils shunted by it. The shunt consists of copper-oxide rectifier units, which have a non-linear characteristic.

A control relay for transformer tap-changing gear consisted of three separate relays mounted in one case. The main part is a special moving-coil with cobalt-steel magnets and wound to operate on a few milliamperes. As this relay is polarised, it has two fixed contacts, so that either of them becomes live when the relay operates in one direction or the other; auxiliary mercury switches and armatures control the current necessary for contactor operation.

Summation metering equipment involves contacts on each meter, so that a local circuit is closed once or more per revolution of the spindle. The summator proper consists of a number of electromagnetic movements, each energised from one meter, and having their armatures mechanically inter-connected, so that each incoming impulse adds up to a final dial, which shows the sum of the individual meter readings at any instant. The printometer (fig. 6) at predetermined intervals governed by a master clock, records on a roll chart the demand which has occurred in any electrical circuit between each pair of successive intervals. When used to record the demand as shown by a number of meters it is operated directly from contacts on the final staff of the summator mentioned above. These impulses, the rate of which is proportional to the total energy, operate printing wheels which add each impulse as received. At the end of the given period the figures are printed on a chart and the whole reset to zero to commence the following period. As printing is done with four digits, the resulting accuracy is proportional to that of an extremely wide chart or long scale. In addition, all impulses received during the printing period are stored and subsequently released so that none is lost.

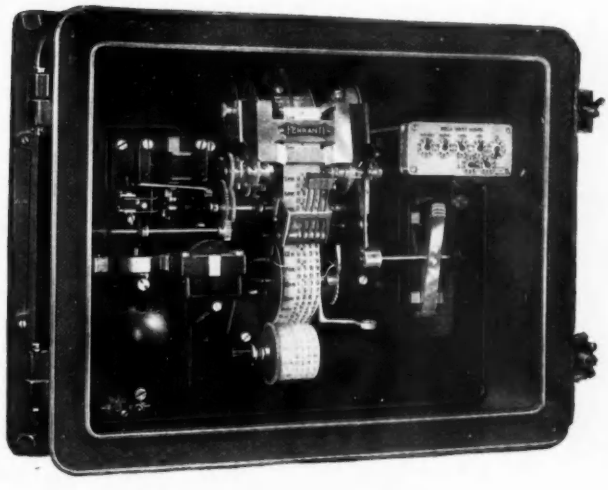


Fig. 6.—Demand Printometer.

Dubilier Condenser Co. (1925), Ltd.

Radio gramophones are constructed in three models, RG2 and RG3 corresponding with the two- and three-valve radio receivers, while model RG4 incorporates a much larger power

amplifier capable of exceptional reproduction of both gramophone and radio music. "Auto-dial" receivers incorporate a device for enabling the tuning to be controlled from one or more points, either close to or at a distance from the receiver itself, which is effected by means of a rotary dial resembling the calling dial of an automatic telephone instrument; it operates mechanism to effect the selection of one of a number of possible tuning positions, which, when once set to the adjustments of several different radio stations, enable a choice of radio programmes to be made at will without any further tuning process.

For the elimination of interference from radio apparatus

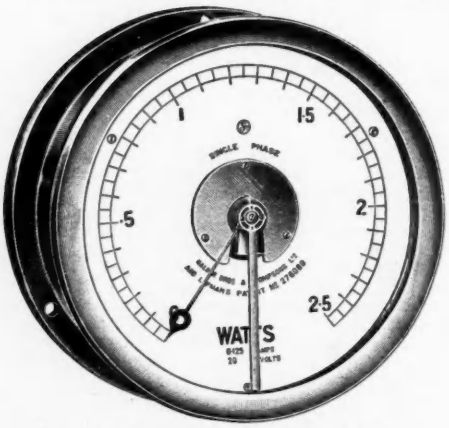


Fig. 7.—Reactive kVA-type Meter.

arising from various sources, such as the commutators of motors, a range of units is available; they include special condensers, resistances, and filter circuits.

General Electric Co., Ltd.

The company's research laboratories illustrated possible illumination applications of vari-coloured hot-cathode discharge tubes.

A photoelectric photometer has been developed to enable simultaneous measurements of lumens and lumens per watt to be made on direct reading scales.

A portable telephotometer, which is in the experimental stage, has been developed for the measurement of surface brightness in artificially-lighted streets, for which purpose it is necessary to use a photometer with a very small field of view, particularly in a vertical plane. The instrument is small enough for use on models, and it is possible to measure the brightness of a target 1 cm. wide at a distance of 10 metres, the angular field being about three minutes of arc in the smaller dimension. In addition, it has been found possible to use the instrument for measurements of illumination at a distance, keeping the instrument, observer, and the accessory apparatus

Fig. 8.—Square Ammeter.

stationary and in any convenient location. This method would appear to have possibilities for the testing of street-lighting illumination.

A long-range standard variable condenser has been designed for measuring grid-anode capacities of screen-grid valves, for which purpose a maximum range of 0.1 $\mu\mu$F is required. The capacity variation is calculated from the geometry of the electrodes, changes can be read directly to 0.001 $\mu\mu$F, and estimated to one-tenth of this value.

A large cooled-anode valve of very recent design will take 100 kW input and has been tested at 20,000 volts; it has three filaments in parallel, each taking 75 amperes at 30 volts, the filament leads being water-cooled. The two condenser microphones exhibited showed further improvements on the approximately flush type diaphragm demonstrated last year.

Loading coils for telephone cables exhibited showed the improvement in quality and in reduced size obtained by the use of nickel-iron alloys in powdered form; an incidental advantage is that the material, being in powder form, can conveniently be examined by X-ray analysis.

In the development of heat-resisting alloys of the nickel-chromium type, considerable improvement has been effected by melting the alloys in hydrogen, which has the effect of reducing any oxide that may be present in the material.

The introduction of small mercury rectifiers for supplying the anode voltages of radio receivers has called for the design of a simple time switch to delay the switching-on of the high voltage to the plates of the rectifiers. The necessary interval is about 30 seconds, and it is obtainable by using the time lag of an indirectly-heated cathode valve with a relay in its anode circuit, which closes contacts appropriately; a variable filament resistance affords control over the time lag.

Nalder Bros. & Thompson, Ltd.

This firm has now added a reactive kVA meter to the list of first-grade induction-type instruments. It is designed to measure the wattless (idle) component of the current and is similar to a wattmeter for the same kind of circuit (fig. 7) but modified in such a way that the phase displacement between the series and shunt fluxes is 180 deg. on a non-inductive load instead of 90 deg. as in the wattmeter. The indications are thus proportional to the product of voltage by amperes by sin ϕ, where ϕ is the phase angle between the load current and the supply pressure. The length of scale is about 17 in.

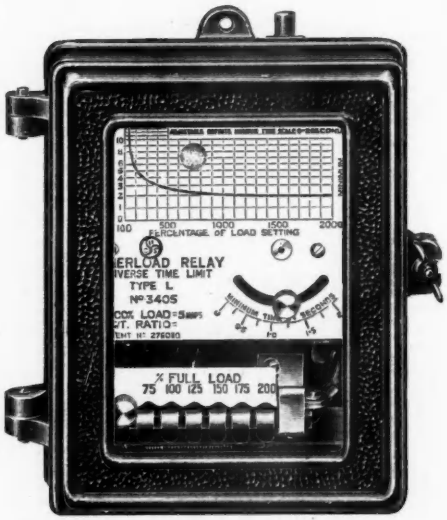


Fig. 9.—Overload Relay.

for the 8-in. diameter dial instrument. They can be supplied suitable for single-phase or polyphase (balanced and unbalanced load) circuits, features being high working forces, light moving system, low volt-ampere consumption, and dead-beatness of movement.

Also shown for the first time was a neatly designed portable phase sequence indicator, which shows at a glance the sequence in which the e.m.f.'s of a three-phase system reach their maximum values; the windings are suitable for voltages from 50 to 500 volts at any commercial frequency. It is only 2¾ in. in diameter, 1¾ in. deep, and weighs only 7 oz.

In order to meet modern requirements for rectangular and square instruments, a series of this pattern has been exhibited, of which an ammeter is illustrated in fig. 8. Very small "Bijou" ammeters and voltmeters (2½ in. dia.) can be supplied in moulded cases of the flush or projecting types.

The display of a large number of protective relays of modern design embodying improved characteristics, as selected for the protection of certain sections of the national grid, included the single-pole overload relay illustrated in fig. 9, which class of relay is also manufactured in double-pole and triple-pole cases.

Tramway Congress.

The Council of the Tramways, Light Railways and Transport Association has accepted an invitation of Mr. J. A. Forde, general manager of the Isle of Thanet tramway undertaking, to hold its annual congress at Margate on May 27th to 29th, 1931.

The Kingsway Tramway Tunnel.

Features of the electrical equipment in the reconstruction scheme of the London County Council Tramways.

APART from the main tramway equipment, there are several features of particular electrical interest in connection with the reconstructed Kingsway and Aldwych subway of the London County Council tramways which was re-opened on January 15th by Major R. I. Tasker, chairman of the L.C.C., who rode through the tunnel in a special white, gold, and blue double-deck tramcar, fig. 1, thus restoring direct communication between North and South London, but on a larger scale.

Between Holborn station and the nearest exit of the subway at Southampton Row, where the mean gradient is 1 in 10, automatic light signals have been installed to prevent a car from entering the section until the previous car has passed through. A direct-acting switch in the conductor slot is pushed over by the plough on the passage of a car, and this operates a specially designed "Igranic" relay which controls the lamps. In each signal there are two lamps in parallel, and duplicate relays are also provided with a change-over switch to provide against failures and to minimise any traffic delays. The station platforms are 4 in. above the track rails, and tubular lamps behind prismatic reflectors are installed in the kerb of the platform, fig. 2, opposite the "gate" in the conduit to throw light under the car, when required, to facilitate examination of the plough. Floodlights controlled by local switches are installed at every crossover.

The beam supporting the roof of the subway where the latter is widened at the stations comes immediately above the centre of the platform. In each recess formed by the corrugated-steel roof and the supported beam (2 ft. 6 in. centres) is tucked away a 100-W floodlighting prismatic reflector specially designed by Holophane, Ltd.; the reflectors are set at an angle of 25 deg. below the horizontal. Approximately 50 of these concealed floodlighting fittings on each side of the centre beam throw their light on to the white glazed tiles and coloured advertisement matter on the opposite walls, giving a brilliant shadowless illumination all over the platform, fig. 2. Seven special "Ascog" fittings connected to the supply company's mains serve for decorative effect and emergency lighting.

Fig. 3.—Illumination in Subway Proper.

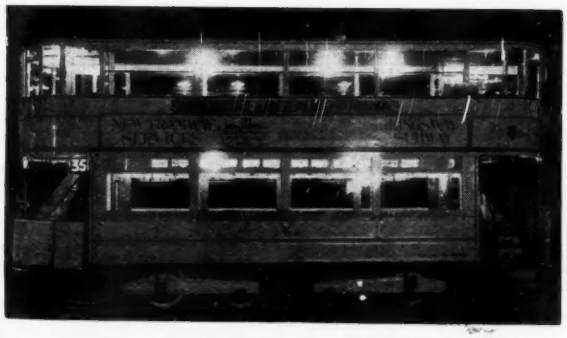


Fig. 1.—Illuminated Tramcar at Subway Re-opening.

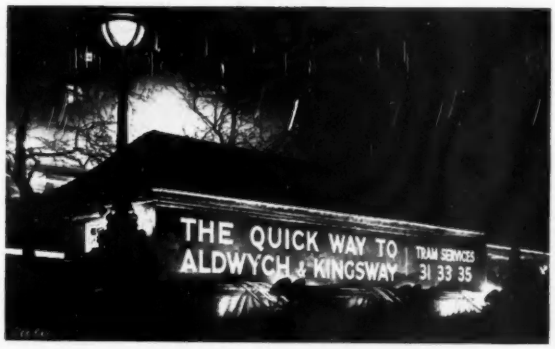


Fig. 4.—The Westminster-shelter Sign.

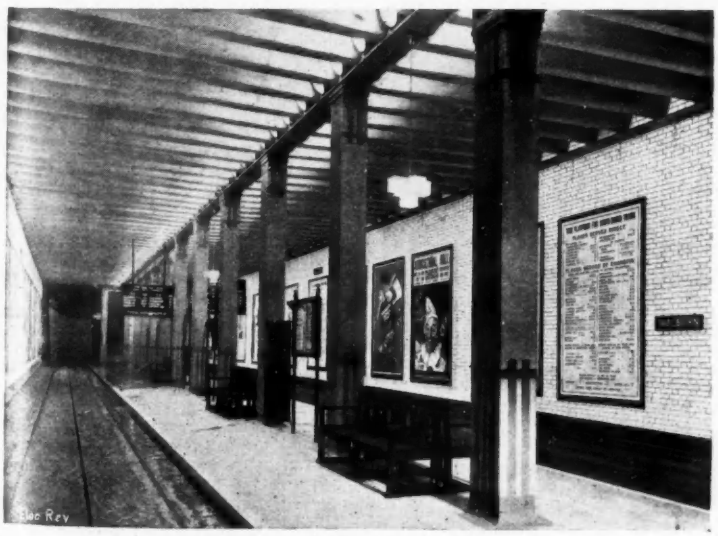


Fig. 2.—Lighting Arrangements at Holborn Station.

In the subway between the platforms four types of multi-plane street-lighting reflectors, supplied by the Electric Street Lighting Apparatus Co., are used. These reflectors confine the light to the narrow elongated area of the subway, so that it is not dependent on the roof or walls, which have low reflecting values, to act as reflectors. The result is that one 100-W lamp and a reflector every 100 yards gives adequate illumination throughout the subway, fig. 3. Siemens electric lamps are employed throughout the stations and tunnel, as well as on the cars.

In connection with the opening of the subway an interesting notice board has been fixed to the back of the Westminster tramway shelter. This is illuminated at night by six "Holophane" projector units, and is thus clearly visible across the whole length of Westminster Bridge, fig. 4.

The electrical work referred to in the above notes was carried out to the specification of Mr. John H. Parker, M.I.E.E., electrical engineer to the L.C.C. tramways.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this section.

Improved Coil-winding Machine.

Considerable improvements have been made in the "Quick-way" coil-winding and forming machine for armature and stator coils, fig. 1, produced by the MIDLAND DYNAMO CO., LTD., Volta Works, Belgrave Gate, Leicester, during the past few years. It is a sturdy machine built to withstand heavy strains, and it will wind and form any size of coil made with covered wire. Any number of wires can be wound and formed together, and square, round or rectangular conductors may be used. The standard machine winds coils of standard diamond shape with an evolute each end, and coils of other shapes can be made; specially-designed parts are offered to suit sample coils submitted. Wire is used from drums arranged on a frame provided. The tension on each wire is adjustable, and the coils are wound with each turn an exact length to allow for correct radial shape. The wires are supported on six members, two on each side called side guides, and one on each end called end guides. All six supporting members are adjustable along a graduated scale on which all dimensions may be tabulated. Setting up from dimensioned records or from a sample coil takes four or five minutes, and making repeat coils is simple if records are kept. Once set, every coil is produced alike until the machine is reset. Winding is made easy because the wires group automatically as they are drawn along to be formed. An adjustable swivel grip holds the ends of the wires, and a foot pedal operates a sensitive and powerful clutch which smoothly sets the machine in motion and winds the coil. The four side guides are each fitted with a patent adjustable grip box, and these instantly grip the wires symmetrically and tightly together. Levers quickly release both end guides to enable the coil to be opened or formed. A quick-acting foot pedal engages gears, and power is then applied for shaping the coil, which is released by a quarter-turn of six levers. One spanner provides for all adjustments. A girl or a youth can make 20 to 30 coils per hour.

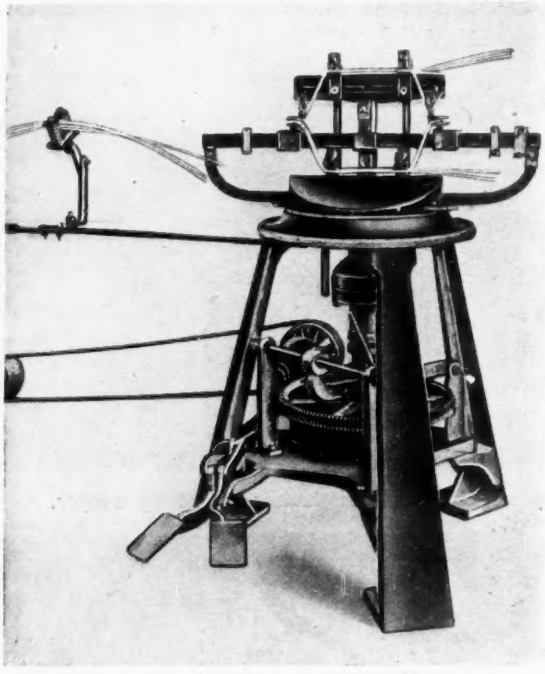


Fig. 1.—"Quickway" Coil-winding Machine.

A New High-speed Diesel Engine.

Messrs. MIRLEES, BICKERTON & DAY, LTD., Hazel Grove, near Stockport, have recently put on the market a new type of high-speed Diesel oil engine known as the "Mirrlees-Ricardo" engine, fig. 3, which is the result of co-operation between the makers and Mr. H. R. Ricardo. This engine is manufactured in two groups of sizes, *viz.*: 20 b.h.p. per cylinder, 1,200 r.p.m., in units of 3, 4, 5, and 6 cylinders; and 50 b.h.p. per cylinder, 900 r.p.m., in units of 3, 4, 5, 6, and 8 cylinders. The engine is of the 4-stroke, cold-starting type, and employs sleeve valves instead of the usual poppet valves situated in the cylinder heads. The use of sleeve valves enables a high degree of turbulence to be obtained, with consequent complete mixing of the air and fuel, resulting in economy of fuel and freedom from troubles due to bad combustion. The solid-injection type of fuel-feed system is used, both the suction and the spill valves of the fuel pump being mechanically operated. Governing is obtained by means of a circular wedge which varies the duration of opening of the spill valve according to the load on the engine. The weight varies from about 40-50 lb. per b.h.p., according to the size of the unit, and a fuel consumption of as low as 0.38 lb. per b.h.p.-hour has been obtained.

Improved Meter Cover.

BRITISH INSULATED CABLES, LTD., Prescot, Lancashire, are now fitting to their two-rate a.c. meters, PA 2, a new type of cover with a single large glass window covering both the dial and the name and data plate, in accordance with the latest practice, fig. 2. The meter itself is of the induction-motor type, and is similar in general design to the makers' PA type, except that it has a double dial recording high and low rates, and an electro-magnetic device for switching over from one rate to the other.

Fig. 2.—"B.I." Meter with New Cover.

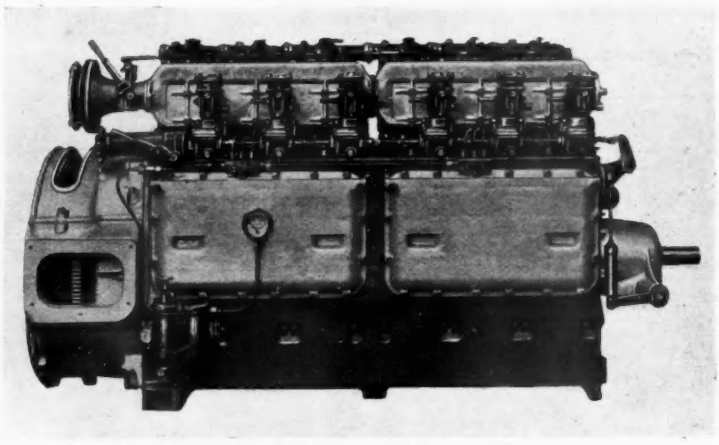


Fig. 3.—Six-cylinder, 120-b.h.p. "Mirrlees-Ricardo" Engine.

Extra-high-voltage Laboratories.

The technical characteristics and lay-out of equipment used for testing at one million volts and over, and some of the dielectric phenomena that become apparent at such high pressures.

(Extracts from papers read before the INSTITUTION OF ELECTRICAL ENGINEERS.)

AT last week's meeting two papers were presented on the allied subjects indicated by the above main and sub titles. One of them discusses the breakdown of air, oil, and solid dielectrics by normal-frequency, impulsive, and high frequency voltages; a large amount of original numerical data is included, covering the entire range of pressure up to one-million volts. The other paper discusses in detail the principal components of the e.h.p. equipment with which such investigations are made.

Testing Equipment.

Messrs. E. T. Norris, M.I.E.E., and F. W. Taylor, B.Sc., (Tech.), A.M.I.E.E., make recommendations with the object of guiding intending purchasers in deciding upon the best type of plant to install and in specifying the most suitable technical characteristics, and of helping owners and operators of existing equipment to appreciate the possibilities and limitations of their apparatus and thereby making full and efficient use of it. They reveal the high place which British work has reached in high-voltage engineering, and make it obvious that e.h.p. laboratories cover a very wide range both in size and in scope. The likelihood that two having exactly the same equipment and specification will ever be required is small; moreover, even in such an event different local conditions would almost certainly prevent duplication, which variations make it impossible to standardise layouts. The best that can be done is to lay down certain guiding principles, to indicate desirable arrangements, and to point out the numerous pitfalls to be avoided. Four modern high-voltage laboratories are described.*

(*a*) *Scientific Research.*—The National Physical Laboratory, at Teddington, has three high-voltage transformers giving 1,000,000 volts r.m.s. to earth when connected in cascade, each individual unit being rated at 375 kV. A distinctive feature of the equipment is that the transformers are of the air-insulated type.

(*b*) *Cable Works.*—The plant installed at the North Woolwich works of Standard Telephones and Cables, Ltd., is an excellent example of a comprehensive cable-testing equipment. The transformers have a capacity of 450,000 volts and 300 kVA (continuous thermal rating), depending on the connections; since it was not considered desirable to obstruct the overhead travelling crane, the high-voltage busbars are supported from the floor on towers built of porcelain tubes, instead of being hung from the roof by suspension insulators. A special high-voltage selector switch enables any busbar to be connected to the sphere spark-gap, oscillograph, or wattmeter, from outside the high-voltage enclosure while the equipment is alive. While the high-voltage transformers were under construction they were experimentally fitted with tappings for cascade connections and with all three so connected at the maker's (Ferranti) works, a pressure of over 1,000,000 volts was produced for the first time in this country.

(*c*) *Switchgear or Transformer Works.*—The apparatus permanently installed by Messrs. Ferranti, Ltd., at Hollinwood, Lancashire, includes a 1,000,000-volt low-frequency testing equipment, a 1,000,000-volt surge generator, and a 300,000-volt Schering bridge. The high-voltage low-frequency plant includes two interchangeable 500,000-volt transformers which can be connected in series, in parallel, or in cascade for 1,000,000 volts to earth. They are of the horizontal type and are of sufficient capacity to pressure-test power transformers of well over 100,000 kVA rating. A particular feature of one of the transformers is a means for inserting and varying an air-gap in the magnetic circuit so that the power factor of the transformer, which is always lagging, can be reduced to compensate for the low leading power factor of the load due to the apparatus under test. The adjustment can be made while the transformer is alive, and in this way the kVA taken from the supply can be reduced and the power factor raised to nearly unity. This equipment, by the way, formed the first 1,000,000-volt laboratory to be established in this country.

For the surge generator, employing six stages of the Marx circuit, the initial rectification is effected through 220-kV thermionic valves, and six banks of condensers are employed. The generator is in practically continuous use in connection with testing and experimental work on surge absorbers and on transformer insulation, as well as on the distribution and values of surge stresses in transformer windings. This work is so varied that the generator has been so designed as to be easily portable, and has, indeed, been used out-of-doors and for sending 1,000-kV surges into a full-size 60,000 kVA power-transformer winding. Extremely valuable technical information has been obtained with this generator regarding the effects of lightning surges on transformer insulation between turns and coils, and between windings and the core and case.

The Schering bridge was originally intended for testing condenser bushings only, but within a very short time its unique qualities as regards detecting flaws and defects in the quality of insulation without damaging it were utilised more widely. At present the bridge is in continuous use day and night, whilst a second bridge having a different range and application is under consideration. The bridge has two important uses, first, in ensuring that any given insulation is of good quality before it is built into a machine or before expensive work is done on it, and, secondly, in detecting whether such insulation has been damaged by the pressure tests called for in the standard or customer's specification. Cases have occurred in which apparatus has apparently passed the specified pressure test satisfactorily, but with subsequent examination the Schering bridge showed that it had been permanently damaged and was unfit for its ordinary working conditions.

(4) *Bushing or Insulator Works.*—At the Stourport works of Steatite and Porcelain Products, Ltd., the low-frequency equipment consists of two 500,000-volt transformers, each with a thermal rating of 225 kVA, which can be connected in series, in parallel, or in cascade for 1,000,000 volts at 450 kVA. The arc rating of the transformers is exceptionally high and another distinctive feature is the horizontal porcelain terminal. Other equipment includes a surge generator, built on the Marx principle for 1,800,000 volts (peak), and a high-frequency generator of 1,500,000 volts (peak value).

The paper is mostly a record of the experience of the authors during the last 11 years in the design and construction of high-voltage testing equipments, and their thanks are due to Messrs. Ferranti, Ltd., for permission to publish the information.

Dielectric Phenomena.

Messrs. B. L. Goodlet, A.M.I.E.E., F. S. Edwards, B.Sc., A.M.I.E.E., and F. R. Perry, M.Sc. (Tech.), Student I.E.E., refer to the considerable difficulty of correlating results obtained by various investigators, and explain that, when starting a large e.h.p. laboratory at Trafford Park, they determined that work should not be merely at the dictate of expediency, but so far as was possible in accordance with a reasoned survey of the whole field under review. Their paper contains the preliminary results of those investigations, which cover a wide field, many of the investigations having no apparent connection with each other. After dealing with methods of measurement, the authors state some of the results obtained; for instance:—

Part 1.—*Normal Frequency A.C.*—Some peculiar phenomena are mentioned relative to the breakdown of air and oil at large spacings, being somewhat similar. It was noticed that the results were somewhat different according to whether the oil was circulated slowly or quickly. A possible explanation is that in stagnant oil the gas evolved by an arc passing between the electrodes rises towards the surface and, provided a reasonable time is allowed to elapse, the products of the arc will have risen clear of the gap before the voltage is re-applied. When the oil is in violent circulation a proportion of the gas evolved remains suspended in the oil and is circulated through the gap; thus, the breakdown value of the oil in violent circulation after several breakdowns will be of the same order as that obtained with aerated oil.

The effect of the circulating process on the control gap was very marked, the breakdown value when circulated showing an average reduction to 66 per cent. of its normal value.

Dependence of the results on the electric strength of the oil used, as determined by the B.E.S.A. gap, have been conflicting. In the case of the non-discharging electrode a relation of direct proportionality between electric strength and large gap breakdown voltage appears to exist. In the case of the point electrode, which discharges violently prior to spark-over, the breakdown voltage is entirely independent of the electric strength over the range investigated.

The investigations made at large spacings indicate that the breakdown voltage increases with temperature only when it is coincident with the starting voltage, *i.e.*, when no discharges precede the spark over; when spark-over *is* preceded by discharges the temperature dependence either disappears or operates in the opposite direction.

* See also the following ELECTRICAL REVIEW references:—(N.P.L.) August 17th, 1928, p. 267. (Standard) September 7th, 1928, p. 383. (Ferranti) January 11th, 1924, p. 61. (Steatite) May 26th, 1930, p. 976. (Metrovick) March 7th, 1930, p. 439. (Micafil) August 17th, 1928, p. 267.

Part 2.—High-frequency Impulsive and Direct Voltages.—The main point of interest is the considerable difference in the spark-over voltage according to the polarity of the high-voltage electrode. With electrodes of unequal size at large spacings (when discharges precede spark-over) spark-over invariably occurs at a lower voltage when the smaller electrode has positive polarity. This rule holds both for impulsive and direct voltages; with alternating voltages spark-over generally occurs in the half-cycle when the smaller of the two electrodes is positive. With electrodes of unequal size at small spacings when discharges do not precede spark-over, this generally occurs at a lower voltage when the smaller electrode has negative polarity. The starting voltage of discharges is in general lower with the small electrode negative; hence, when starting and sparking voltages are coincident, the spark-over voltage will also be lower as stated above.

Oil breakdown with impulsive and high-frequency voltages seems to depend very little upon the oil quality, and such factors as temperature have very little influence. It would, in fact, appear that with impulsive voltages we measure the true breakdown voltage of the oil gap without matters being complicated by the various secondary phenomena which appear at normal frequencies. The dependence of spark-over voltage on polarity found in unsymmetrical gaps in air is present also in the case of oil; moreover, the phenomenon is governed by the same rules. This similarity is strong evidence in support of the view that the underlying mechanisms of air and oil breakdown are not very different in nature.

Large mechanical forces are set up on the breakdown of an oil gap under impulsive voltage. It would appear that the sudden passage of the spark sets up in the gap a very high local pressure which then travels out as a pressure wave. Many cases of movement of the electrodes have been noted and on several occasions when making observations with the sphere-plane gap, a hollow copper sphere 12.5 cm. diameter and 0.2 cm. thick was dented over an inch as by a hammer blow, solid spheres having to be used in consequence. This effect appears to be associated with the rapidity with which energy can be fed into the gap on breakdown occurring. With the usual kind of apparatus at normal frequency the electrode capacittance is not very great.

Part 3.—Breakdown of Solid Dielectrics.—It is only of recent years that a real understanding of the phenomena is beginning to be obtained. The mechanism of failure in the low-temperature range is still far from being understood. In the high-temperature range the facts are, however, in the main explained by the thermal theory. Since this theory of failure is the only one having any practical applications at the present time, the authors examine it in some detail. The phenomena of thermal instability do not at the present time entail any insurmounable difficulties in practical work. They do, however, enforce the necessity for the most scrupulous care in the selection and manufacture of the insulating materials employed in situations where thermal instability is a factor. The only line of escape from the trammels is precisely in the continued improvement of the dielectric employed: the whole concept is bound up with the increase of the dielectric losses with temperature and is utterly inconceivable if these losses are independent of temperature or decrease as the temperature increases.

All experimental work described was carried out in the researeh laboratory of the Metropolitan-Vickers Electrical Co., and the cathode-ray oscillograph without which much of the work would have been impossible was designed and constructed under the supervision of Mr. F. P. Burch.

Discussion.

Dr. E. H. Rayner described with the aid of lantern slides the N.P.L. plant, in the design of which flexibility of use had been one of the major considerations. No porcelain was used in the transformers or their supporting insulators. Unless such equipment enabled something to be measured, or a better method of measurement to be evolved, it was not fulfilling its proper function. When a galvanometer that would "sit still" in an e.h.p. laboratory became available then something new would be learned.

Mr. B. H. Leeson referred to one of the original 500,000-V transformers installed in this country; it had been worked hard for seven years without trouble of any kind. About a ton of copper and three ground plates had been used to enclose the building in a sort of squirrel cage for thoroughly earthing it, which arrangement had entirely obviated trouble due to discharges taking place where they should not do so. Interlocking safety arrangements were very necessary and some elaboration was justified to make quite sure. He had found a motor-generator better than an induction regulator for voltage control, and the fixed control desk had been abandoned in favour of a movable plug-in table. For research the oil used should be very clean so as to avoid the results obtained being masked, whereas for routine testing it should more nearly approximate to its normal operation condition.

Mr. W. E. M. Ayres said that in very few cases was the induction regulator really the source of voltage disturbance; the whole outfit (generator, transformer, and regulator) should be designed for good wave-form. Sphere gaps could be made to do anything; real voltage measurement was more desirable, for which purpose some good devices were on the market.

Mr. W. A. Coates referred to the doubt that might possibly be cast upon the utility of the B.E.S.A. oil-test gap specification by certain references in one of the papers; and explained that, except when clearances were small and reliance could be placed on the oil remaining clean, allowance for the normal condition of the oil was made in practice by providing larger clearances. Mr. Goodlet's oscillography showed great improvement and his method of associating the cathode-ray with the main spark was thought to be entirely novel.

Mr. J. A. Harle pointed out that watts-loss tests were essential in solid dielectric investigations; he showed slides of apparatus designed for that purpose, and bushing test-result curves.

Mr. N. E. P. Harris, dealing with the practical application of arcing rings, was inclined to think that the tendency was to set gaps too long, because tests were carried out with clean insulators, whereas contamination by dirt and moisture would make the spark-over value smaller and smaller. Enclosed-air bushings were by no means dead; he had designed some the previous week.

Mr. T. N. Riley remarked that the e.h.p. test plant in his works had worked well for six years and reflected credit on Mr. Norris. Alternative methods of control were used, as alternator-field regulation was more accurate for power-factor tests. Recently plant had been installed for cable life tests and had been run for weeks together as an unattended substation. As a measure of quality, power-factor tests had superseded the old breakdown and d.c. insulation tests.

Mr. C. G. Garton wanted to know whether the placing of oil barriers in transformers was really a wrong policy. Discussing shapes and sizes of spark gaps, he stated that spark inaccuracy could be avoided by the use of a small auxiliary arc to illuminate the main gap with ultra-violet light.

Mr. P. Dunsheath said he had very strong feelings on the subject of safety devices. They were a snare and were better avoided altogether. They had once nearly caused a serious accident to himself; he now relied on visual watching and the avoidance of any place where a man could be hidden out of sight. A new principle he suggested was that instead of determining dielectric breakdown voltage they should measure the minimum voltage at which any deviation from excellence was noticeable. When some form of ionisation point was obtainable, then they could commence to talk of critical values.

Prof. E. W. Marchant observed that oil breakdown seemed to be always due to the collection of particles between the electrodes, and tests with unpurified oil did not signify anything. Breakdown seemed to be due to gradual ionisation, something like polarisation in a battery cell.

Mr. B. L. Goodlet, briefly replying, was inclined to agree with Mr. Dunsheath's views on safety devices.

Mr. E. T. Norris drew attention to the great improvement of induction regulators during the last few years, but observed that no manufacturer of either induction or motor-generator regulators would be prepared definitely to guarantee wave-form.

Ferranti Lecture.

Extracts from an address delivered in Manchester on the first anniversary of the pioneer's death.

ABOUT 400 members of the various electrical groups in Manchester and district assembled under the auspices of the Electrical Power Engineers' Association at the College of Technology, Manchester, on January 14th, the first anniversary of the death of Dr. S. Z. de Ferranti, to hear a memorial address on his life and work, which had been prepared by Mr. Frank Bailey, M.I.C.E., M.I.E.E., chief engineer and managing director of the City of London Electric Lighting Company, who was prevented by illness from delivering it in person. Mr. H. C. Lamb, manager and engineer of the Manchester Corporation electricity department, deputised admirably and Mr. V. Z. de Ferranti presided.

When at St. Augustine's Abbey school, Ramsgate, between 1877 and 1880 Ferranti was encouraged to exercise his inventive faculty, and there he produced an arc lamp and his first dynamo, which ran at 2,000 r.p.m. and had a cast-iron armature. It is to the honour of that school that it did not urge him to work for examination, but offered him special tuition. During the year he spent at University College he found it very difficult to learn, as he was so anxious to get on with practical work. He succeeded in being admitted to Messrs. Siemens's works at Charlton in 1881 where Sir William Siemens employed him to carry out some experiments on the first electric furnace; by making a magnetic field round the crucible rotation of the molten steel was obtained and two years later the young inventor applied that phenomenon as the principle of the mercury meter which was to become, after much tribulation, one of the ornaments of his fame.

He had those qualities that can be best summed up as "genius." Training which would have been irksome to him might have retarded the full flow of his inventive mind.

In 1882 he was busy with a motor-focussing arc lamp, using a core of fine steel wire in the carbon to centralise the arc; he then made a rotary-field motor, forecasting modern design; a sort of sun lamp formed by carbon dust packing in a hole drilled in marble; and then took out his first patent for the zig-zag (ribbon) armature, which ultimately became one of the marvels of mechanical construction. With the assistance

of Mr. Ince a company was formed in 1882 to work that invention and, as Sir William Thomson (later Lord Kelvin) anticipated the design, they arranged to pay royalties and the machine was known as the Thomson and Ferranti alternator.

That company went into liquidation at the end of 1883, but Ferranti bought back his patents, formed his own company, and thus laid the foundations of the enterprise which now flourishes at Hollinwood.

Patent No. 15,251 was remarkable as a prophetic vision of modern transmission. In undertaking the duties of chief engineer of the Grosvenor Gallery Company he was armed with technical knowledge far in advance of his time. The promoters accepted a bold scheme to place the generating works at Deptford, about eight miles away from the point of supply, and to use concentric mains for transmission at 10,000 volts. To carry out that scheme the London Electric Supply Corporation was formed to purchase the Grosvenor Gallery Company, and then the National Society for the Distribution of Electricity by Secondary Generators, owners of the Gaulard and Gibbs system, sought to injunct Ferranti for infringement of its patents, but threats did not deter him from petitioning for revocation on July 10th, 1888, which was granted by the High Court and subsequently confirmed by the Court of Appeal and the House of Lords. That was indeed good progress for a young man of 24.

In November, 1890, the Grosvenor station was destroyed by fire, and 26,000 lamps were in consequence lost by transfer to competitors. The Deptford works commenced a regular supply in February, 1891, after much conflict with the Post Office Telegraph Department and the Board of Trade about earthing the outer conductors of the concentric mains. Induction troubles on telegraph lines were cured by such earthing, and the Board of Trade withdrew its objection after a conclusive demonstration of the safety of the method carried out by Mr. Harold W. Kolle, an old and loyal assistant, who held a chisel while it was driven through one of the concentric mains when alive at 10,000 volts. Happily, Mr. Kolle is still with us.

Many orders for engine-alternators were carried out, and the happiest times of Mr. Bailey's life were spent in visiting the various towns with Ferranti when he was erecting plant. Engine building ceased in 1904, and the company's loss necessitated reconstruction. At that time the works had been removed to Hollinwood.

The oil-break switch, one of the most useful inventions, was designed when it was most wanted and was made with great promptness in 1895. In a short time there were 60 panels at work at Bankside (subsequently increased to 80 panels), and they worked without the slightest hitch for 28 years.

On the formation of the British Insulated Wire Co. about 1890 the promoters invited Ferranti to join them, giving him a substantial interest in the company and insuring his life for £20,000 for some years.

Of a number of patents by Ferranti in connection with cables several are of primary importance even to-day, for in 1888 (No. 2315) he protected the idea of "an electrical main composed of thinly insulated wires so put together that each wire has the same average distance from the centre of the main"; for high-frequency wireless work it is now in common use and sometimes called Litz wire. Another important patent was taken out in 1897 (No. 3363) to enable strands to assume any desired form by rolling or hammering, and in Patent No. 22923 (1892) he described a three-core shaped-conductor cable of the section commonly in use to-day, and also a twin concentric type with two D-shaped conductors twisted together and surrounded by the third conductor in concentric form; the segmental form of conductor was due to Ferranti also.

Patent No. 2313A (in 1888) was the first and master effort to provide a perfect means of smoothing (filtering) the ragged edge of a uni-directional current; incidentally, it was a clear anticipation of the audio-transformer.

No fewer than 367 patents were taken out, of which 207 were in Ferranti's name alone, and the extraordinary growth of the works at Hollinwood from 1895 to the present date is a monument to his enterprise. In 1897 about 700 employés were at work; now there are 4,500.

After the works had been out of his control for ten years, following the reconstruction of the company, Ferranti returned to the task of modernising all plant, perfecting the business organisation, and adopting the most accurate automatic machines (designing them when necessary). He must have been a happy man, and he certainly had the gift of inspiring others with his enthusiasm and charming personality.

The proceedings terminated with a silent tribute to the great leader.

Overhead Transmission Control in France.

In view of the great extension of overhead electric power transmission lines in France, the French Ministry of Public Works has recently set up a special control department. For the purpose of properly carrying out the work the country has been divided into nine areas with offices, respectively, in Lille, Rouen, Angers, Bordeaux, Toulouse, Grenoble, Bourg, Nancy, and Paris. Each of the offices will act as a central control department, but the local supervision will remain in the hands of the chief engineer of each department or province.

Legal.

A Scottish Rating Appeal.

THE Scottish Lands Valuation Appeal Court, Edinburgh, on January 23rd, heard an appeal by the Clyde Alloy Steel Co., Ltd., Shieldmuir, Motherwell, against the assessment placed upon its works, offices, and land by the Assessor for the County of Lanark. One of the furnaces used at the company's works is a high-frequency furnace operated by 1,000-V single-phase a.c. Electricity is supplied by the Clyde Valley Electrical Power Co. in the form of 11,000-V three-phase curent. The energy is stepped down from 11,000 to 440 V and then supplied to a motor-alternator producing single-phase current at 11,000 V.

In estimating the annual value of the appellants' subjects, the Assessor considered that the cables, transformer, and plant in the appellants' work up to and including the motor should be treated as plant for producing or transmitting first-motive power, and therefore heritable within the meaning of Section 42 of the Valuation Act, 1854, as amended by the Lands Valuation (Scotland) Amendment Act, 1902. The effect of the latter provision is that the expression in the former statute, "machinery fixed or attached to any lands or heritages," is construed as including all machinery, machines, or plant on the lands or heritages for producing or transmitting first-motive power or for heating or lighting the building, but does not include machines, tools or appliances which are only so fixed that they can be removed from their place without necessitating the removal of any part of the building. The Valuation Committee for the County of Lanark sustained the view of the Assessor.

Lord HUNTER considered that the appeal should be dismissed. He said that the appellants' main contention was that the entire plant from the introduction of the cables to the works right to the furnace must be regarded as one unit for the production and application of heat to the furnace and was neither for the production nor transmission of first-motive power. He was of opinion that this contention was not well founded. All the plant up to and including the motor was plant for producing first-motive power. His Lordship referred to the case of the Etna Iron and Steel Company, decided in 1919. In that case machinery in certain ironworks was driven by two electric motors supplied with energy by cables from the generating station of a power company. It was held in that case that the motors were machinery for producing or transmitting first-motive power. Lord Salvesen in that case said: "The electric current is not motive power at all until it has passed through these motors. It then becomes motive power."

Lord Sands and Lord Fleming concurred, and the appeal was accordingly dismissed.

Infringement of Chloride Patent.

MR. JUSTICE MAUGHAM, in the Chancery Division on January 22nd, granted an injunction, with costs, to the Chloride Electrical Storage Co., Ltd., of Manchester, against Barnett's Wholesale Wireless and Electrical Accessories, restraining infringement of a patent. The matter came before his Lordship on a motion for judgment in default of defence.

His Lordship also directed that there should be an inquiry as to damages, the costs of which were reserved.

Railway Electrification in Madras.

(By Our Indian Correspondent.)

GOOD progress is being made in Madras with the electrification of the railways; the suburban section is at present provided with one single metre-gauge track with passing loops at stations. With the work now nearing completion, there will be two tracks from Madras Beach to Madras Egmore, and three from Madras Egmore to Tambaram.

The first stage of the scheme now being undertaken comprises the electrification of two tracks between Madras Beach and Tambaram, a route distance of 18 miles, which together with sidings will make a total single-track distance of 43 miles. The third line, between Madras, Egmore, and Tambaram, will not be electrified at present. The whole electrification scheme has been so designed that it will be possible to extend out to Cingleput, 19 miles from Tambaram, without any dislocation of the existing plant or services.

The two electrified tracks are intended primarily for suburban passenger traffic, but at certain times of the day they will also be used by goods trains hauled by electric locomotives. The section is being electrified on the direct-current system at a pressure of 1,500 V., and multiple-unit rolling stock with pantograph collectors will be employed.

The electrical energy required for the operation of the electrified services is received at a pressure of 5,000 V, a.c., at the Egmore sub-station, where it is converted to 1,500 V d.c. by

means of metal-type mercury-arc rectifiers. Step-up transformers are also installed at this sub-station and electrical energy is transmitted to the Minanbakkam sub-station by means of a 33,000-V, 3-phase, 50-cycle duplicate circuit transmission line. This transmission line is erected on independent towers within the boundary of the railway property. An extension of the transmission line is provided from Minanbakkam sub-station to Tambaram for the supply of electrical energy to the car shed and classification yard and other railway buildings.

Considerable care has been exercised in order to obtain sub-station buildings which will satisfactorily house the electrical plant. The difficulties encountered in a climate such as that of Madras in keeping out dust and vermin have made it necessary to take several precautionary measures.

The electrified suburban tracks between Madras Beach and Tambaram, and the single main steam line between Madras, Egmore and Tambaram are equipped with three- and two-aspect daylight signals, coloured red, yellow, and green. It may be of interest to know that the light from each aspect is visible in full sunlight, for a distance of not less than 2,000 ft.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

Wages in the Contracting Industry.

The interesting reply and scolding "Ex-Councillor E.C.A." put forward in his letter appearing in your issue of January 16th rather misses its mark, I am afraid.

I am not in business as a contractor, but am merely one of those employers who make a fair use of electricity and, in doing so, endeavour to pay the local standard rate to wiremen. So far that has been done, but, with all the goodwill in the world, I greatly dislike this new agreement which, in effect, says that an increase of 3s. weekly is due to wiremen on account of the rise in the cost of living. The argument is really too absurd and would not stand investigation against the latest figures of the Ministry of Labour.

I agree, Sir, with the remark in your leaderette—for which I thank you—in respect of the benefits of stability for the next year or so. It is, undoubtedly, good for electricians to know that their rate of wages will remain at the present standard for that period. In that part of England from which I write many other classes of workmen would be glad to know that their wages would be stabilised for the same period, but, alas, I am afraid they will not be.

Meanwhile I abide by the opinions expressed in my letter of the 3rd inst

Hadsum.

January 19th, 1931.

Careers for Young Engineers.

Correspondents have separately recommended that technical training should be acquired before or after a period of practical training, but they have not included the possibility of the young engineer receiving a training in which technical education is properly sandwiched with periods of works training.

The best all-round engineer, the term "engineer" being used in the broad sense for designer, salesman, or production engineer, is one who is able to combine to the very best advantage his practical experience and his theoretical knowledge, and it is therefore a great advantage if, during the period of his training, the two qualities have been correctly intermingled.

The disadvantage of placing the technical education before the period of practical training as cited by "H.T.C." is as real as the possibility of the absorption powers of the student being dulled by too long a period of works training as suggested by "Student," but the process of sandwiching the technical and practical training removes both these disadvantages at once; particularly so if the works training is supplemented by part-time day studies, in which case the student's mind is refreshed during the time that he is acquiring commercial experience.

I would strongly recommend this course to "Pater," whether it be carried out at such training centres as the Northampton Engineering College or Faraday House, London, or by similar arrangements at Universities in other parts of the country.

There is at least one large engineering firm in this country which has made special provision for the training of engineers in this manner. Its course provides for a preliminary training lasting some seven to ten months, during which time the student receives a works training with opportunities for attending organised part-time day-course lectures in technical matters. The period of preliminary training is sufficiently long to enable the student to become stabilised in his surroundings, which is not always possible if the period is made shorter, as in the case of vacational training alone.

Then follows the University or technical college training lasting for three or four years, part of each summer vacation being devoted to further works training. After graduation, the student returns to complete a two years' apprenticeship with the company. By the end of this time the student has received a training extending over some five and a half years, and has had the technical and practical parts thoroughly intermixed. This, in my opinion, is the secret of a successful and efficient engineering training.

It is realised, of course, that this system can be taken advantage of only by those whose training is not of necessity confined to part-time technical studies.

H. Peasgood.

Manchester, *January 21st*, 1931.

The Student's View-point.

I was very interested in the short article by an "Engineering Lecturer" in your January 16th issue, as I have often found a similar mental attitude of students even older than those mentioned by your contributor. Too often the student is only speaking the actual truth, and the last paragraph of the article referred to explains the reason. "The world of the professional lecturer and that of the student may easily become two entirely separate realms."

I have had over 20 years' experience in giving technical instruction in electrical engineering to engineering and mining students, mainly in evening classes. In such classes the majority of the lecturers are men engaged primarily in business, and consequently in everyday contact with practical affairs. Such men look on theory as a handmaid to practice and are always ready to give a practical illustration to demonstrate their point. I have found, however, that in courses which extend over four to five years of training the authorities are inclined to entrust the mathematical and purely theoretical work to professional teachers, whose daily work is very far removed from practice. Unless there is very close co-ordination between the theoretical man and the practical man, the student is inclined to get the idea that the equations and symbols which he learns in the theoretical class are of very little use to him in his daily work.

As principal teacher in charge of several electrical engineering courses, I have found it of distinct advantage to discuss periodically with those I may term the theoretical men the points they are taking up, and to make suggestions as to how they ought to treat particular points. By keeping in touch in this way with the student's progress in the other classes comprising the course, I am able to refer them to the theory and point out how such theory is actually applied in practical work.

There certainly is difficulty in teaching engineering in a laboratory, but I find that the modern tendency is more and more to make the engineering laboratory an *engineering workshop* wherein examples of everyday practice can be seen and studied by the student under the guidance of a practical man. I think, also, an extension of the system whereby the regular teaching staff is supplemented by lectures by men engaged in the everyday business of life is necessary.

I am pleased to note from the remarks in your leader column that you apparently agree with this point of view.

J.D.M.

January 20th, 1931.

Cable Troubles.

I notice Mr. W. Maskery's comments on my reported remarks at the discussion on Mr. L. R. Lee's paper. Unfortunately the reporter's drastic abbreviation of my remarks has completely altered their sense. What I tried to convey at the meeting was the advantage of abolishing "wiped" joints. I know I am a dreadful heretic in suggesting such a thing and advocating a "soldered" joint, but I may point out that the latter takes only a fraction of the time, is much easier to make soundly, is infinitely stronger than a "wipe," and uses, instead of the 10 lb. to 2¼ lb. of metal mentioned by Mr. Maskery, only a few ounces. Moreover, there is less chance of damage to the cable by overheating. There is only one thing against it, namely, it is not a pretty study in black and white as is the "wipe."

A "wipe" joint, either in electrical or plumbing work, is only a custom prolonged by conservatism.

A. F. Harmer.

Wimbledon, *January 24th*, 1931.

Electrolysis and Rubber.

We have recently experienced an unusual electrolytic phenomenon. A piece of twin tough-rubber-sheathed cable of well-known make connected to one side of a d.c. 3-wire system was found to be earthing. On examination the wires were found to be quite bare and the rubber covering to have agglomerated into a sticky mass about the size and shape of a Brazil nut. The electricians reported that the cable was alive and sparking even when the main fuses were removed. The piece of cable was removed and laid on a chair; to their surprise the "sparking" continued, and the cable was brought in for examination.

The wires are bare and clean and not corroded. The rubber, however, on close inspection is seen to be a mass of slow effervescence; when squeezed, slightly corruscations of brilliant sparks about an inch long appear, leaving narrow trails of thick white smoke.

We assume that under electrolytic action the sulphur of the vulcanised rubber has combined with the sodium or potash of the plaster, giving rise to either an unstable salt or the pure metal which immediately re-hydrates upon contact with moisture. The colour of the flame suggests pure sodium.

The cable is now in the hands of the analyst attached to the borough power station. We hope to hear further of the matter in due course.

Teesdale & Jones.
W. I. JONES.

Swindon, *January 23rd*, 1931.

Published Specifications.

Compiled expressly for this journal by a firm of chartered patent agents. The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1929.

20,012. "Process for manufacturing high-emission cathodes for thermionic valves." Dr. B. Loewe. June 30th, 1928. (314,551.)
23,227. "Methods of and apparatus for television." E. L. Peterson. August 18th, 1928. (317,475.)
23,417. "Filaments for electric incandescent lamps." Falk Stadelmann and Co., Ltd. (H. Mendel). July 30th, 1929. (340,473.)
25,784. "Electric signalling systems, particularly telephone systems." Telephone Manufacturing Co. (1929), Ltd., R. J. W. Kennell, and J. F. Grimbley. August 23rd, 1929. (340,478.)
26,358. "Light-sensitive cells and like devices." L. Keeskemeti-Kaye and British Talking Pictures, Ltd. August 29th, 1929. (340,527.)
26,403. "Electric condenser, especially for multiple valves." Loewe-Audion Ges. and Dr. E. Romhild. August 31st, 1928. (318,259.)
28,385. "Means for amplifying electric impulses." C. Marshall. September 19th, 1929. (340,552.)
28,625. "Overhead electricity supply systems and fittings for making multiple connections to the aerial electric lines thereof." J. E. Steward, R. T. Norton, and Bullers, Ltd. September 20th, 1929. (340,554.)
28,645. "Counting arrangements for totalisator and other totalising apparatus." Ericsson Telephones, Ltd., and F. Limb. September 21st, 1929. (340,515.)
28,690. "Grid electrodes of vacuum electric tube devices." E. Y. Robinson and Associated Electrical Industries, Ltd. September 21st, 1929. (340,516.)
28,864. "Entrance die for vacuum impregnating tank for electric cables." Western Electric Co., Ltd. (J. F. Wentz). September 23rd, 1929. (340,556.)
28,891. "Electric glow-discharge devices." Electrical Research Products, Inc. March 25th, 1929. (340,557.)
29,045. "Electromagnetic separators, work-holders, and similar devices." F. Storch, Jun. September 25th, 1928. (319,668.)
29,227. "System for the cooling of electrical and similar machinery at low temperatures." M. Semenza. September 26th, 1928. (319,707.)
29,296. "Printing telegraph apparatus." Standard Telephones and Cables, Ltd., and E. M. S. McWhirter. September 27th, 1929. (340,583.)
29,367. "Electrical device and method of determining distances." A. A. Thornton (Radio Frequency Laboratories, Inc.). September 27th, 1929. (340,531.)
29,537. "Electric distant transmission of angular positions." Compagnie des Forges et Aciéries de la Marine et d'Homecourt and E. Granat. November 6th, 1928. (340,561.)
29,728. "Advertising and like arrangements, comprising luminous discharge tubes." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). October 1st, 1929. (340,536.)
29,732. "Adjusting device for electric condensers." Wilkins & Wright, Ltd., and J. H. Hewitt. October 1st, 1929. (340,537.)
29,756. "Voltage regulation of electric transformers by changing tappings under load." Ferranti, Ltd., and E. D. T. Norris. October 1st, 1929. (340,538.)
29,821. "Method of, and apparatus for, illumination with a continuous play of colours." Landis & Gyr Soc. Anon. January 8th, 1929. (340,565.)
29,846. "Cord circuit repeaters." Standard Telephones and Cables, Ltd., L. P. Lowry, and C. G. Connolly. October 2nd, 1929. (340,567.)
29,847. "Supporting structure for electrical instruments." Standard Telephones and Cables, Ltd., J. S. P. Roberton, and L. H. Webb. October 2nd, 1929. (340,568.)
29,848. "High-frequency receiving systems." Standard Telephones and Cables, Ltd. February 6th, 1929. (340,569.)
29,852. "Prepayment devices used with telephone instruments." Siemens Bros. & Co., Ltd., and G. F. Dutton. October 2nd, 1929. (340,595.)
30,051. "Grids for electric cells." Honeycomb Batteries, Ltd., and R. H. Brown. August 5th, 1930. (340,626.)
30,100. "Plugs and the like for electric circuits." R. T. Waite. October 4th, 1929. (340,609.)
30,136. "Loading of electric conductors." Electrical Research Products, Inc. November 6th, 1928. (340,610.)
30,137. "Submarine cable systems." Electrical Research Products, Inc. May 31st, 1929. (340,611.)
30,138. "Television systems." Electrical Research Products, Inc. December 21st, 1928. (340,612.)
30,165. "Oil-filled cables." British Thomson-Houston Co., Ltd. October 4th, 1928. (340,614.)
30,167. "Thermionic amplifiers." M. E. Elliott. October 4th, 1929. (340,615.)
30,260. "Electromagnetic relays." Automatic Telephone Manufacturing Co., Ltd., and M. O. Williams. October 5th, 1929. (340,620.)
30,549. "Circuit arrangements for automatic telephone systems." Telefonaktiebolaget L. M. Ericsson. March 7th, 1929. (340,634.)
30,550. "Rotary distributors particularly for electric telegraph systems." Electrical Research Products, Inc. October 8th, 1929. (340,635.)
31,022. "Tramway trolley, 'bus, or like trolley heads." Metropolitan Electric Tramways, Ltd., and J. Schofield. October 12th, 1929. (340,643.)
31,260. "Reduction of echo effects in electric signalling systems." H. G. Davis and H. V. Clark. October 15th, 1929. (340,650.)
31,453. "Electric lamps." R. E. D. Maradei. October 16th, 1929. (340,654.)
32,356. "Interconnection of the connecting wires of electrical apparatus." S. A. Mabey. October 24th, 1929. (340,671.)
33,659. "Dynamo-electric machines." D. B. Hoseason and Associated Electrical Industries, Ltd. November 5th, 1929. (340,690.)
33,753. "Dialling handle for use with automatic telephone." A. J. Bone and G. A. Bone. November 6th, 1929. (340,692.)
33,770. "Telephone circuits." A. R. Kahl and Coventry Automatic Telephones, Ltd. November 6th, 1929. (340,693.)
33,829. "Electrical switches." Associated Electrical Industries, Ltd. November 6th, 1928. (340,696.)
34,651. "Conductive shields and screens for electric discharge devices." British Thomson-Houston Co., Ltd. November 24th, 1928. (340,708.)
34,937. "Telephone systems." S. C. Winfield-Smith, S. Cauthery, and Burovox, Ltd. November 15th, 1929. (340,715.)
35,381. "Starters for internal-combustion engines." P. Viet. January 28th, 1929. (340,721.)
37,043. "Doors of electric furnaces." Hirsch, Kupfer-und Messingwerke Akt. Ges. March 11th, 1929. (340,730.)
37,749. "Synchronous electromotors." Kienzle Uhrenfabriken Akt. Ges. December 8th, 1928. (340,740.)
38,962. "Electric projectile fuses." Rheinische Metallwaaren-und Maschinenfabrik. June 14th, 1929. (Addition to 283,585.) (340,764.)

1930.

304. "Internal-combustion engine ignition systems." P. M. Bruner. January 3rd, 1930. (340,784.)
517. "Electric lifts." A. Schindler and A. Sigg (trading as Schinder and Co.). January 29th, 1929. (340,791.)
1,037. "Circuit breakers for use in alternating-current electric circuits." Electrical Apparatus Co., Ltd., and R. H. Barbour. January 10th, 1930. (340,797.)
1,369. "Electric junction boxes." G. N. Haden & Sons, Ltd., C. M. Davis, and C. King. January 14th, 1930. (340,803.)
1,728. "Electric telemetering systems." British Thomson-Houston Co., Ltd. January 18th, 1929. (340,805.)
1,983. "Electric bell or the like indicators." General Electric Co., Ltd., J. R. Conchie, and W. Manchester. January 20th, 1930. (340,809.)
3,175. "Portable electrical connectors." H. D. Wight, J. S. Hawthorne, and Sunderland Forge and Engineering Co., Ltd. January 30th, 1930. (340,828.)
3,305. "Instruments for continuous colour-television transmitting and receiving apparatus." G. M. Bowtell. January 31st, 1930. (340,833.)
4,879. "Acoustic signalling apparatus." Naamlooze Vennootschap Maschinenfabriek G. Dikkers & Co., and J. H. Timmer. February 13th, 1930. (340,840.)
6,234. "Charging electric accumulator batteries." O. Akerman and Allmänna Svenska Elektriska Aktiebolaget. February 25th, 1930. (340,855.)
6,585. "Inductance coils." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. March 2nd, 1929. (340,859.)
6,663. "Alternating current motors." W. W. Triggs (Utah Radio Products Co.). February 28th, 1930. (340,860.)
6,957. "Electricity meters of the induction type." Allgemeine Elektricitats Ges. March 2nd, 1929. (340,864.)
6,994. "Insulators for sparking plugs." I. G. Farbenindustrie Akt. Ges. March 1st, 1929. (340,865.)
7,050. "Electric switchgear installations." Felten & Guilleaume Carlswerk Akt. Ges. March 7th, 1929. (340,867.)
7,412. "Handle switches for electro tools." Siemens-Schuckertwerke Akt. Ges. March 14th, 1929. (340,870.)
9,114. "Picture and like transmission systems." Marconi's Wireless Telegraph Co., Ltd. March 22nd, 1929. (340,886.)
9,384. "Electric cables." Rheinische Draht-und Kabelwerke Ges. and H. Glaser. March 24th, 1930. (340,888.)
9,674. "Dynamo-electric machines." Associated Electrical Industries, Ltd. March 26th, 1929. (340,890.)
9,801. "Magnet cores of electric measuring instruments of the induction type." Landis & Gyr Soc. Anon. April 11th, 1929. (340,891.)
9,835. "Radio antenna systems." Marconi's Wireless Telegraph Co., Ltd. March 29th, 1929. (340,892.)
12,852. "Electric water-heating devices." H. Arber. March 25th, 1930. (340,908.)
13,777. "Electric bell-ringing devices." F. R. Plagens. May 4th, 1929. (340,913.)
15,157. "Cutting the plates or grids for electrical accumulators." Britannia Batteries, Ltd. (Accumulatoren-Fabrik Akt. Ges.). May 16th, 1930. (Convention date not granted.) (340,915.)
15,506. "Electric power installations on aeroplanes." Scintilla Akt. Ges. June 28th, 1929. (340,916.)
15,844. "Piezo-electric oscillators and the like." Marconi's Wireless Telegraph Co., Ltd. June 20th, 1929. (340,918.)
16,039. "Rotary electric transformers." M-I. Magneto Syndicate, Ltd., and R. H. Woodall. May 24th, 1930. Addition to 310,198.) (340,919.)
21,094. "Illumination of sound films." Zeiss Ikon Akt. Ges. July 29th, 1929. (340,924.)
21,563. "High-tension electric cables." British Thomson-Houston Co., Ltd. July 16th, 1929. (Addition to 312,081.) (340,925.)
33,677. "Electric telephone and like transmission systems." Electrical Research Products, Inc. June 11th, 1929. (Divided application on 26,378/29.) (340,624.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 21st:—

Sphinx. No. 491,855. Class 8. Radio transmitting and receiving apparatus and parts thereof, &c.—Parlophone Co., Ltd., 1, Broad Street Place, E.C.2.

Clarion. No. 511,886. Class 8. Thermionic valves.—Octron, Ltd., 32, Charlotte Street, Birmingham.

Stevebac. No. 517,480. All goods in Class 8.—Sarah W. Stephens, 12, Bedford Road, Sandy, Beds.

Signavox. No. 518,227. Class 8. Radio-telephonic, telegraphic, and television transmission and receiving sets and parts thereof.—Signal Gesellschaft Dr. Erich F. Huth, Berlin. (British representatives: Marks & Clerk, 57-58, Lincoln's Inn Fields, W.C.2.)

Drydex. No. 518,848. Class 8. Electric batteries and accumulators (not for medical purposes).—Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.

Vitamilk. No. 517,464. Class 11. Lamps for the treatment of milk and milk foods with ultra-violet rays.—British Hanovia Quartz Lamp Co., Ltd., Trading Estate, Slough.

Temset. No. 515,310. Class 13. Switches (ordinary) for electric heaters and cookers.—C. R. Belling, trading as Belling & Co., Bridge Works, Southbury Road, Enfield, Middlesex.

Tektam (lettering and design). No. 517,200. Class 50. Electrical insulating substances of asbestos and mica, &c.—Chemical Building Products, Ltd., 59, New Oxford Street, W.C.1.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ALTRINCHAM.—Additions to County High School for Boys; F. Anstead Browne, county architect, Newgate Street, Chester.

AYLESHAM (KENT).—R.C. schools; Rev. Peter O'Neill, 38, Clarendon Road, Aylesham.

AYR.—Houses (215) for the T.C.; burgh surveyor. School, Kilmarnock (£38,000), for the Ayrshire county E.C.; director of education, Ayr.

BATH.—Rebuilding business stores for William McIlroy, Ltd.

BEXLEY.—Houses (239), Welling, for J. Stevens & Sons. Houses (64), Barnehurst estate, for W. H. Wedlock, Ltd.

BLACKPOOL.—Branch library, Marton; borough surveyor.

BOURNEMOUTH.—Business premises, Tuckton Road; Jones and Baines. Fire station (£16,500); borough engineer. Alterations and additions, Gordon Hotel, Overcliffe Drive; W. G. Gubbons. Alterations, Hotel Metropole; Levy & Franks, Ltd. Additions, Overcliffe Hotel, Grand Avenue; R. & M. Foulsham. Alterations, Queen Victoria Hotel, Wimborne Road; Strong & Co.

BRADFORD.—Stores and workshops for the Education Department, Southfield Lane; city architect. Telephone exchange; Postmaster-General.

BRIGHTON.—Houses (193), Whitehall estate (£73,533); W. John Llantrisant. Rebuilding King and Queen Hotel, Marlborough Place; Edlings, Ltd.

BUCKINGHAMSHIRE.—School, Bradenham, for the county E.C.; director of education, Aylesbury.

BURTON-ON-TRENT.—Reconstruction of business premises, Station Street, for Jay's, Ltd., 248, Tottenham Court Road, London, W. School; Howe and Shirley Knight, architects, London. Telephone exchange for H.M. Office of Works, King Charles Street, London, S.W.

CHESHIRE.—Schools, Northwich and Weaverham, for the county E.C.; director of education, Chester.

CHESTERFIELD.—Houses (600) during the next five years; borough engineer.

CLEETHORPES.—School for Lindsey E.C.; H. G. Gamble, county architect, Bank Street Chambers, Lincoln.

CROYDON.—Senior school and extensions, Norbury Manor and Ingram schools (1,120 places), for the borough E.C.; education officer, Katharine Street.

DONCASTER.—Houses (50), Askern, for the R.D.C.; surveyor.

DURHAM.—Central hospital (£22,000) for the County Council.

EAST SUSSEX.—Girls' secondary school, Hove, for the county E.C.; director of education, Lewes.

GATESHEAD.—Baths (£75,000) for the Town Council.

GLAMORGAN.—School (400 places), Skewen, for the E.C.

GLASGOW.—Extension of high school, Elmbank Street (£50,000); Executive Officer to the Education Authority. Central school, Wyndford, for the E.C. Extensions, Bothwell Street; J. & P. Coats, Ltd.

HEBBURN.—Houses (400) during the next five years for the U.D.C.

HERTS.—Schools, Croxley Green and Rickmansworth; director of education, Hertford.

HULL.—Re-erection of Palais de Dance, electrically equipped (£30,000); proprietors.

LEEDS.—Re-arranging Kirkstall Road depôt (£10,800); city engineer.

LEOMINSTER.—Houses (50) for the T.C.; J. Budd, borough surveyor.

LONDON (EAST HAM, E.).—Receiving wards and nursery block; Public Assistance Committee.

(POPLAR, E.).—Reconstruction of central baths (£138,537); borough engineer.

LONDON (*Continued*).

(HENDON, N.W.).—Temporary school (400 places), Mill Hill, for the E.C.

(LEWISHAM, S.E.).—Cinema, Loampit Vale and Molesworth Street; Gaumont British Picture Corporation, Ltd.

(ROTHERHITHE, S.E.).—Offices, Lawrence's Wharf, Rotherhithe Street; Gillman & Spencer, Ltd.

(WOOLWICH, S.E.).—Houses (2,200), Eltham estate; John Sutcliffe, borough engineer.

(EALING, W.).—Houses (252), Briarhill estate; W. R. Davidge, architect, 5, Victoria Street, S.W. Shops and flats (19), Boston Road; Hall-Jones & Dewhirst, architects. Flats (171), Madeley Road; G. W. Smith, architect.

(KENSINGTON, W.).—Clearance and flats, Talbot Grove (£43,500); borough engineer.

MANCHESTER.—Erection of Astoria Cinema, Heaton Park; J. Gerrard & Sons, Ltd., builders, Swinton.

NORRIS GREEN.—Church; Bernard Miller, architect, 10, Glenmore Road, Birkenhead.

READING.—Houses (50), Berkeley Avenue, and shops (12), Boston Avenue, for R. Curtis. Houses (2,000) during the next five years for the T.C.; borough surveyor.

REDDITCH.—Public offices; U.D.C. surveyor.

REDHILL.—Post office for H.M. Office of Works, King Charles Street, S.W.

RICHMOND-ON-THAMES.—Fire station and quarters (£20,965) for the T.C.; borough engineer. Showroom, Thames Street, for F. W. Woolworth & Co., Ltd.; Mr. Priddle, architect, Victory House, Kingsway, W.C.

ROCHDALE.—Alterations to Townhead offices; borough surveyor.

SALFORD.—Municipal garage; city engineer.

SOUTHEND-ON-SEA.—Town hall (£350,000); Professor Adshead.

SOWERBY BRIDGE.—Re-erection of works for Lilywhite, Ltd.; A. F. Sergeant, managing director.

STOCKPORT.—Houses (3,700) during the next five years for the T.C.; borough surveyor.

STOCKTON.—Municipal offices (£45,000) for the T.C.

SUNDERLAND.—Electrical work for new administrative block at the Royal Infirmary; W. & R. T. Milburn, architects, 17, Fawcett Street.

SWANSEA.—Houses (54), Townhill estate, and three branch libraries; borough architect. New wards, Swansea General Hospital, Phillips Parade; governors. Senior school, Kilvey (£53,081); Griffith Davies & Co.

SWINDON.—Houses (550) during the next five years for the T.C.; borough surveyor.

TYNEMOUTH.—Senior school at Linskill for the E.C.; W. Stockdale, 81, Howard Street, North Shields.

WALLASEY.—Swimming bath, Harrison Drive (£25,000); borough engineer.

WEST RIDING.—School, Kiveton Park (£18,650), for the E.C. Colony for the mentally defective, Oulton Hall estate (£225,650), for the C.C.; clerk, Wakefield.

WHITEHAVEN.—Employment exchange for H.M. Office of Works, King Charles Street, London, S.W.

WIGAN.—Re-erection of Ross Works, Tunstall Lane, Highfield, for Lord & Sharman.

WILLINGTON.—Public baths (£12,000) for the U.D.C.

WOLVERHAMPTON.—Cinema for the Cinema Proprietors, Ltd., Garrick Street; Satchwell & Roberts, architects.

WORCESTERSHIRE.—Senior school, Cathshill, for the county E.C.; director of education. County high school, Redditch (£33,988); H. B. Tarleton, builder, Redditch.

YEOVIL.—Cinema theatre (£14,000); Lucas & Langford, architects, Exeter.